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LAND MOLLUSCA OF BAJA CALIFORNIA, MEXICO

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ABSTRACT: The native land mollusk fauna of Baja California, including the islands of the Pacific coast and the Gulf of California, consists of 117 species and subspecies, distributed among 36 genera of 18 families. All but the amphibious prosobranch *Truncatella* are pulmonates. Three additional species have been introduced through human activity. Two new species, *Rabdotus (Plicolumna) perhirsutus* (in Bulimulidae) and *Greggelix (Matirelix) huertai* (in Helminthoglyptidae) are described. Locality lists and synonymic notes are given for all species; distribution maps are provided for most. Three principal land molluscan faunal regions are recognized: Californian, Sonoran, and Cape. The Californian and Sonoran regions are further divided into zones. These biogeographic divisions correspond rather closely to phytogeographic and other zoogeographic subdivisions proposed for Baja California.

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INTRODUCTION

The land mollusks of Baja California include a varied, highly endemic group of species that even today are incompletely known. The Baja California peninsula extends approximately 1,300

km from the United States/Mexico border south-southeasterly to Cabo San Lucas. Rugged terrain, extreme aridity in many areas, and problems of inaccessibility have made it unattractive to most malacologists. Particularly in the desert regions and rockslide habitats, land mollusks occur sparsely and are difficult to find in living condition.

The purpose of this paper is to summarize the composition and geographic distribution of the

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land mollusk fauna. Previous published records have been critically reviewed. The bibliography includes all references to Baja California land mollusks that introduce new taxonomic or distributional information. Taxonomic status and distributional records are based on examination of the major collections of Baja California land Mollusca—chiefly those of the U.S. National Museum of Natural History, Academy of Natural Sciences of Philadelphia, California Academy of Sciences, Santa Barbara Museum of Natural History, University of Arizona, and the private collections of authors Miller and Christensen. All newly cited localities have been verified by one or more of the authors, with section responsibility principally as follows: Miller—Succineidae, Helminthoglyptidae; Christensen—Subulinidae, Bulimulidae, Oleacinidae; Miller and Christensen—Valloniidae, Strobilopsidae, Punctidae, Oreohelicidae; Miller, Christensen, and Roth—Truncatellidae, Pupillidae, Haplotrematidae, Helicodiscidae, Arionidae, Zonitidae, Megomphicidae. Two new species are described. Several new synonymies are introduced. Many bulimulid localities here published for the first time were originally cited in a revisionary thesis by Christensen (1978).

This report is the outgrowth of a manuscript begun by Allyn G. Smith in consultation with the other three authors but left unfinished upon his death. The three of us (Miller, Christensen, Roth) acknowledge our profound debt to Allyn for his conviction that a distributional list of Baja California land mollusks was necessary and timely, for his thorough review of the history of investigations in the region, and for making many of the original identifications. Final responsibility for species determinations, however, rests with us, as indicated above.

ACKNOWLEDGMENTS

Thanks are due to the late Joseph C. Bequaert for nourishing the interest of authors Miller and Christensen in minute mollusks, and for commenting on an early draft of the paper. We are grateful to colleagues W. L. Pratt, Richard L. Reeder, F. M. Climo, and the late S. Stillman Berry for discussion of taxonomic aspects of the study; to Judith Terry Smith for specimens collected during her geologic field work in Baja California; to Gene Coan for advice on taxa named by Henry Hemphill; to Peter LaRochelle and C.

Clifton Coney for comments on Pupillidae; and to Dick Reeder, Jim Hoffman, Judith Christensen, Betty Sue and William Nixon Miller, Jim Cartwright, Noor Babrakzai, Diana Warr, and H. Lee Fairbanks for valued companionship in the field. Arthur E. Bogan arranged the loan of type material under his care. Stanley C. Williams and Vincent F. Lee kindly provided base maps. Dennis E. Breedlove conscientiously brought us mollusk specimens he collected during his botanical explorations. Peter U. Rodda supported and aided production of the report. The late George Radwin called author Miller's attention to two shells collected by Reid V. Moran in the Cerro de la Mina de San Juan, setting in motion the events that led to the discovery of *Greggelix (Martirelix) huertai*. Acknowledgment is made to the Secretaría de Agricultura y Ganadería, for issuing permits for scientific collecting. The G Dallas Hanna Fund for Scientific Publication supported publication of this paper.

HISTORY OF INVESTIGATION

The first land snail species described from Baja California was the bulimulid *Naesiotus pallidior* (Sowerby, 1833), originally obtained by the famous British shell collector Hugh Cuming. Additional bulimulid species from Cuming were described by Louis Pfeiffer (1846, 1865). Pfeiffer (1845) also described *Xerarionta levis* and *X. areolata*, collected in 1839 by Richard Brinsley Hinds, surgeon-naturalist on the worldwide exploring voyage of HMS SULPHUR. Gould (1853) described two species of *Rabdotus* and one of *Naesiotus* collected by officers of the United States Army and Navy during the Mexican War (Johnson 1964).

An important early source of Baja California land mollusks was the Hungarian naturalist, János Xántus de Vésey. Xántus operated a United States Coast Survey tidal station at Cabo San Lucas in 1859–1861. He is reported to have collected in the mountains of the Cape region and northward for a distance of 560 km up the east coast, although other evidence implies that he never traveled more than about 120 km from his station (Madden 1949). Some of the land snails that he collected are now in the U.S. National Museum of Natural History (USNM) and the Academy of Natural Sciences, Philadelphia (ANSP).

Bulimulid land snails sent by Xántus led W.

G. Binney to infer a zoogeographic relationship between Baja California and Peru, and for a time the idea took root. Binney (1861) first identified the large Cape region species now known as *Naesiotus montezuma* (Dall, 1893) as a superficially similar Peruvian species, *Bulimus* (now *Scutalus*) *proteus* (Broderip, 1832). Tryon (1867:173) listed *B. proteus* as “a Peruvian species, of which a number of young specimens have been collected in Lower California,” illustrated a juvenile shell of the Cape region species, and remarked that it was possibly no more than “an adventitious inhabitant.” Binney and Bland (1869) and Fischer and Crosse (1870–1902) listed *B. proteus* from Cabo San Lucas based on material from Xántus. Cooper (1891:101) remarked, “the occurrence of . . . *B. proteus*, also reported from Lower California as well as Peru or Chili [sic], is made more interesting by the similar occurrence of several plants in both regions which are not found anywhere between.” Only after visiting the California Academy of Sciences in 1892 and examining over 100 specimens collected in the Sierra Laguna by Gustav Eisen and W. E. Bryant earlier the same year was William H. Dall able to conclude that the *Bulimulus proteus* of Peru was not the same as the species from Baja California (Dall 1893a). The concept of biogeographic affinities between the bulimulid snails of Baja California and those of South America has recently been given new life by the demonstration (Hoffman 1988) that several species formerly referred to the North American genus *Rabdotus* are assignable to *Naesiotus*, a widespread South American, Antillean, and Galapagan genus.

John A. Veatch spent the months of June, July, and August 1859 on Isla Cedros prospecting for mineral deposits, especially copper ores. His general report on the topography and resources of the island (Veatch 1869:151) mentions the abundance of “*Helix Veatchiana*” (error for *Arionta veitchii* Tryon, a synonym of *Xerarionta levis canescens*).

The next notable collection of Baja California land snails was made by the geologist, mining engineer, and conchologist, William More Gabb. In the process of investigating mineral resources, Gabb traveled, mostly on horseback, from Cabo San Lucas to San Diego, California, in the period January 5–April 20, 1867, crossing the peninsula several times en route (Gabb 1869). Gabb collected land snails extensively, but his carelessness

in recording locality data has limited their usefulness. Some of his land snails are now in the USNM and ANSP.

The interest of the California Academy of Sciences (CAS) in the fauna and flora of Baja California began in the 1880s and developed rapidly. Gustav Eisen’s (1895:763–764) review of early Academy expeditions into the area provides an interesting and useful chronology:

1. Expedition in March, 1888. W. E. Bryant. Magdalena Island, San Jorge to Comondu and across the peninsula to La Giganta and Loreto. Back by La Giganta, San Gabriel, San Juan. Back through Comondu.

2. Expedition spring of 1889. W. E. Bryant and Chas. D. Haines. Magdalena Island, Santa Margarita Island, San Jorge, Comondu, from there overland to San Gregorio, San Ignacio, Calmalli, Santa Borgia, El Rosario, San Quintin.

3. Expedition September and October, 1890. W. E. Bryant. San José del Cabo, Agua Caliente, Sierra, Triunfo, La Paz.

4. Expedition March to May, 1892. W. E. Bryant, Gustav Eisen. San José del Cabo, Miraflores, Agua Caliente, Santiago, Gulf shore, Sierra Laguna, San Francisquito, La Paz. Espiritu Santa Island, Guaymas, Sonora, Hermosillo, Durasnillas, San Miguel.

5. Expedition September and October, 1893. Gustav Eisen. San José del Cabo, Sierra El Taste, across to Pescadero and Todos Santos. Cabo San Lucas, and back to San José, Miraflores, San Francisquito, Sierra Laguna, Todos Santos.

6. Expedition September, October, November, 1894. Gustav Eisen, Frank H. Vaslit. San José del Cabo, Miraflores, Santa Anita, La Palma, Sierra San Lazaro, El Taste, Piedra Corral. Overland from San José to La Paz by Santiago, San Bartolo, Triunfo, La Paz. Mazatlan, by steamer to San Blas. Overland to Tepic, by land to Mazatlan, via Santiago Ixtuintla, Squinapa, El Rosario, etc.

Nonmarine mollusks from these Academy expeditions were worked up by James Graham Cooper, who reported a total of 63 land and freshwater species, 17 of them new to science (Eisen 1895:766). From 1891 to 1895, Cooper published six taxonomic and zoogeographic papers on the land mollusks (Cooper 1891, 1892a, b, 1893, 1894, 1895); in these he assembled information on the snails collected by Xántus, Eisen and companions, Lyman Belding, Henry Hemphill, and Charles Russell Orcutt. A total of 47 species and varieties of land mollusks are mentioned by name in these papers, which were among the last malacological works Cooper ever published (Coan 1982).

Dall (1893b) recorded 13 species of *Bulimulus* from Baja California, describing two as new. Robert E. C. Stearns (1894) reviewed the collecting results of many scientists whose specimens are in the USNM, beginning with an expedition in 1876 by W. J. Fisher of San Francisco.

and mentioned the contributions made by Capt. Anthony Forrer, Gabb, Henry W. Henshaw, Hemphill, Edward Palmer, and the staff of the U.S. Fish Commission steamer ALBATROSS. Stearns was closely associated with the CAS, serving in various capacities including Vice-President, Curator of Conchology, Director of the Museum, and member of the Committee on Publication. His large personal collection is in the USNM. Stearns (1875, 1904) was the author of the observation, often quoted in molluscan textbooks, that the Baja California snails *Xerionta levis canescens* and *Naesiotus pallidior* survived six years without food or water in a box in his desk.

Unfortunately, most land snails collected by Eisen, Bryant, Belding, and others that had been deposited in CAS were lost in the San Francisco earthquake and fire of 1906. A small amount of material in private collections escaped destruction and has since been deposited in the CAS collection. Some material from these early investigations survives in the University of California Museum of Paleontology, Berkeley, and in U.S. East Coast museums; that which had been forwarded to Dall is now in the USNM.

The French malacologist Jules Mabille (1895) described, without illustrations, 18 species and subspecies of nonmarine snails collected by Leon M. Diguët on the Baja California peninsula and the Mexican mainland. Most of the species were not localized beyond "La Basse Californie," and as Pilsbry (1895) was quick to point out, not compared or contrasted to other species. Ancey (1905) reviewed the taxa, finding many to be synonyms. In 1966, G Dallas Hanna, then Curator and Chairman of the CAS Department of Geology, photographed as many of Mabille's type specimens as could be found at the Muséum National d'Histoire Naturelle, Paris; Hanna and Smith (1968) illustrated 13 of these specimens, suggesting synonymies and allocations for most. Additional revisions of the Mabille Helminthoglyptidae and Bulimulidae were published following a visit by W. B. Miller to the MNHN in August 1971 (Miller 1972; Christensen and Miller 1976b).

In 1896, A. W. Anthony of San Diego, later Director of the San Diego Museum of Natural History, collected along the west coast, visiting Bahía Santa Rosalillita and the islands of Guadalupe, Cedros, San Martín, Natividad, and the

San Benitos (Dall 1900). Charles H. Townsend of the U.S. Fish Commission visited Isla Guadalupe around this time, and "parties from San Diego" collected on Islas Los Coronados, returning with material that was studied by Dall (1900). In 1898–1899, the Hopkins-Stanford Galapagos Expedition, with R. E. Snodgrass and Edmund Heller as participating scientists, landed on Isla Guadalupe and collected land mollusks. A few of these specimens are in the Stanford University collection, now housed at CAS; others, studied by Dall (1900), are in the USNM.

The expedition of CAS to the Galapagos Islands in 1905–1906, aboard the schooner ACADEMY, stopped en route at Ensenada and the islands of San Martín, San Gerónimo, the San Benitos, Cedros, Natividad, and San Benedicto and Socorro of the Revillagigedos group (Slevin 1931). Although Slevin (1931:15) mentions "many dead shells. . . found scattered about in the sheltered gullies" on Isla Natividad, the only land snails from this expedition now in the CAS collection are from the Galapagos.

In the 1920s, CAS sponsored three major expeditions to Baja California, the offshore islands west of the peninsula, and the islands in the Gulf of California. The itineraries have been published in general reports in the Academy Proceedings (Slevin 1923; Hanna 1925, 1926). The first expedition, in 1921, visited several localities on the Sonoran side of the gulf, all of the major gulf islands, and many sites along the eastern shore of the peninsula. The expedition malacologist, Fred Baker of San Diego, concentrated mainly on marine mollusks. Most of the land mollusks, later written up by Hanna (1923), were collected by herpetologist Joseph R. Slevin, botanist Ivan M. Johnston, and entomologists Edward P. Van Duzee and Joseph C. Chamberlin.

The 1922 expedition was sponsored jointly by CAS, the San Diego Society of Natural History, the Scripps Institution for Biological Research, the National Geographic Society, and the government of Mexico. It visited the islands of Guadalupe, San Martín, Cedros, Natividad, the San Benitos, San Roque, Asunción, Magdalena, and Santa Margarita. In addition, landings were made on the west coast of the peninsula at Ensenada, Bahía San Quintín, Bahía San Bartolomé, and Punta Abreojos. Hanna's (1925) general account of this expedition indicates that over 2,000 land shells were collected. Pilsbry (1927) reported on

the nonmarine mollusks, describing 12 new species and subspecies. Specimens from this expedition are deposited in CAS and the San Diego Museum of Natural History.

The third CAS expedition, in 1925, visited Isla Guadalupe, the Revillagigedos group, Las Tres Mariás, Isla Cedros, and Isla San Martín. Mainland stops were made at San Diego, Mazatlán, Cabo San Lucas, Bahía Magdalena, and Bahía San Quintín. The land mollusks, including many new species, were reported on by Dall (1926); they are deposited in the CAS collection.

A primarily botanical expedition in 1946, organized by Ira L. Wiggins of the Natural History Museum of Stanford University (Anonymous 1947), also brought back land mollusks. Specimens are in the S. S. Berry collection, now at the Santa Barbara Museum of Natural History (SBMNH), and are reported here for the first time.

The next institution-sponsored Baja California expeditions were the Joseph W. Sefton Foundation Expeditions of March–May 1952 and March–April 1953 (Arnaud 1970), using the R/V ORCA. Places visited included many offshore Mexican and Gulf islands and mainland points on both sides of the Baja California peninsula. The many land snails collected were deposited in the CAS and S. S. Berry (now SBMNH) collections; most have not been previously reported.

The 1957 Puritan-American Museum of Natural History Expedition to western Mexico visited numerous localities on the mainland of Baja California and nearby islands (Emerson 1958). Ten species of land mollusks were collected (Jacobson 1958); the materials are in the American Museum of Natural History (AMNH).

Beginning in 1958, with support from the Belvedere Scientific Fund, CAS organized a number of expeditions and shorter field investigations in Baja California (Smith 1959; Wiggins 1960a). Land mollusks collected during these expeditions were deposited in the CAS collection and are cited in this report for the first time. The first expedition worked in the Cape region in December 1958 and January 1959. Malacologist on the expedition was A. G. Smith; other personnel included botanists Ira L. Wiggins and Reid V. Moran, herpetologist A. E. Leviton, and entomologist Hugh B. Leech. Collections were made in the area south of La Paz generally along the main roads through El Triunfo, Santiago, Boca de la

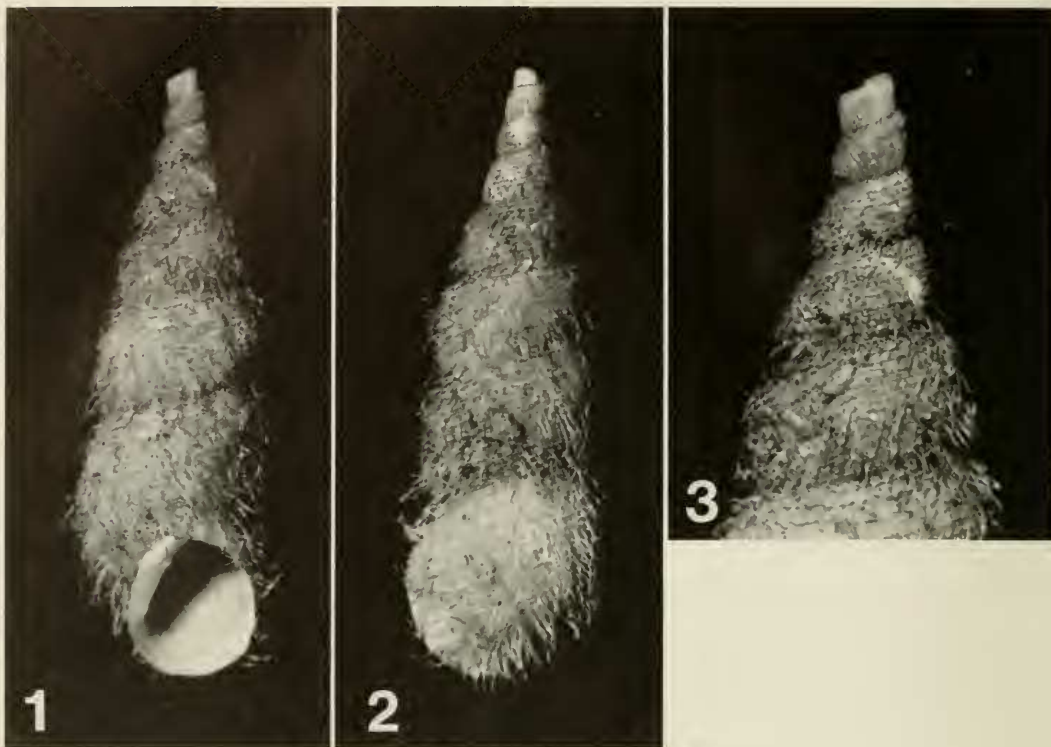
Sierra, Santa Anita, San José del Cabo, Cabo San Lucas, El Pescadero, and Todos Santos. Land snails collected included two species that had not been found since Gustav Eisen's explorations in the 1890s.

A second trip to the Cape region, made in spring 1959, was recounted by Wiggins (1960a). A reconnaissance trip to Bahía de Los Ángeles was made in May of the same year. Land mollusks were collected on both occasions. Again in October 1959, A. G. Smith participated in a CAS-Belvedere Scientific Fund visit to the vicinity of La Paz, adding additional specimens to the CAS collection. In March and April 1961, a CAS party including Smith, Wiggins, and herpetologists Leviton and Benjamin H. Banta explored extensively in the Vizcaino Desert (Wiggins 1969).

In March and April 1962, a Belvedere Scientific Fund-sponsored expedition to the Gulf of California conducted by the San Diego Natural History Museum (SDMNH) visited 32 islands as well as seven stations along the Baja California coast (Lindsay 1962). William K. Emerson and other expedition members collected an extensive series of land shells, later reported on by Emerson and Jacobson (1964). The material was divided between the SDMNH and the AMNH.

Many private collectors have contributed to the knowledge of the land mollusk fauna. Charles Russell Orcutt's collecting extended from the 1880s until 1917, when he spent a month on Isla Magdalena. His field work is mentioned in brief accounts he published as editor of *THE WEST AMERICAN SCIENTIST* (Orcutt 1886, 1891, 1896, 1900a–c, 1915, 1918) and in a biography by DuShane (1971). Henry Hemphill, preeminent among early west coast shell collectors, made a number of trips across the California border in the 1880s and 1890s, visiting Bahía Todos Santos, Santo Tomás, and Bahía San Quintín. His large personal collection is now in the California Academy of Sciences. Shells that he sold as a dealer have found their way into many other museums. Hemphill's short paper in the *JOURNAL DE CONCHYLOGIE* (Hemphill 1881), translated into French by H. Crosse, is one of the earliest faunal lists for a specific portion of Baja California.

Herbert N. Lowe of Long Beach, California, collected land snails along the northwest coast of Baja California in 1912 (Lowe 1913). In November 1931, he organized an expedition aboard



FIGURES 1-3. *Rabdotus (Plicolumna) perhirsutus* sp. nov., shell. Holotype, SBMNH 35110, apertural and abapertural views and enlargement of apex. Height 19.6 mm.

the yacht PETREL, visiting islands east and west of the peninsula (Lowe 1933), and taking large series of land mollusks. Lowe's main collection is in the SDMNH; some of his specimens have come to the CAS by gift or exchange.

Other specialists who have contributed to museum collections and the knowledge of Baja California land mollusks include S. Stillman Berry (whose large collection is now at the SBMNH), Dennis E. Breedlove, Mr. and Mrs. Emery P. Chace, Robert J. Drake, George Willett, and Stanley C. Williams.

In November 1969, Charlotte Church collected extensively in the middle and southern regions of the peninsula for her father, Munroe Walton, who in turn shared his specimens with Wendell O. Gregg and Walter B. Miller. This stimulated Miller to set out in December 1970 to obtain live specimens of what turned out to be the new genus *Greggelix* Miller. In 1972, Carl C. Christensen undertook to revise the genus *Rabdotus* in Baja California for his doctoral dissertation, and a number of expeditions were conducted through-

out the range of that genus. One new species of Bulimulidae, originally diagnosed by Christensen (1978), is described herein. The period from 1970 to date has been devoted to the procurement of live specimens of the species inhabiting the peninsula so that generic and familial relationships can be determined on the basis of anatomical characters. Additional new species and records have continued to come to light as field investigations reach the more inaccessible regions of the peninsula (Christensen 1978, 1983; Christensen and Miller 1975, 1976a, b, 1977; Miller 1972, 1973a, b, 1981a, b, 1982; Miller and Christensen 1980; Roth and Christensen 1984); many of the collection records are reported here for the first time.

DESCRIPTIONS OF NEW SPECIES

Family BULIMULIDAE

Genus *Rabdotus* Albers, 1850

TYPE SPECIES: *Bulimulus dealbatus* (Say) (= *Helix dealbata* Say, 1821), by subsequent designation (Kobelt 1880).

Subgenus *Plicolumna* Cooper, 1895

TYPE SPECIES: *Rhodea* var. *ramentosa* Cooper (= *Rhodea californica* Pfeiffer, subsp.? *ramentosa* Cooper, 1891), by monotypy.

***Rabdotus (Plicolumna) perhirsutus* Miller, Christensen, and Roth, sp. nov.**

(Figs. 1-4)

DIAGNOSIS.—A small, acicular *Rabdotus* (*Plicolumna*) with carinate, projecting embryonic whorls, deeply incised suture, granular to cancellate sculpture, and a thick periostracum bearing prominent, coarse hairs that arise from nodes on the spiral cords.

DESCRIPTION OF SHELL OF HOLOTYPE.—Shell (Figs. 1-3) small for the genus, thin, acicular; apical angle 27°. Whorls 7.6, convex, suture deeply impressed. Embryonic whorls 2.0, projecting, flat-sided, strongly carinate at summit, with strong, regular, axial ribs that are straight on the first embryonic whorl but become sinuous and progressively more retractive on the second; interspaces crossed by minute, close, spiral striae. Early teleoconch whorls sculptured with coarse, retractive collabral rugae and (on third and fourth whorls, eight) nodose spiral cords, producing a granular to cancellate appearance. Periostracum thick, yellowish brown, bearing prominent, coarse hairs that arise from the nodes of the spiral cords; periostracal hairs to 1 mm or slightly more in length. From about fifth whorl on, additional spiral cords arising by intercalation, often not reaching the prominence of other cords, and with surmounting periostracal hairs correspondingly reduced in length. Body whorl a little compressed at periphery, base moderately produced, narrowly and obliquely umbilicate. Aperture ovate, peritreme continuous, margins reflected (most strongly so at base), not revolute, columellar margin rolled over umbilical region and continuous across parietal region as a raised callus. Columella without an entering lamella. Shell under periostracum dull white. Height 19.6 mm; diameter 6.8 mm.

REPRODUCTIVE ANATOMY (based on paratype SBMNH 35111).—The reproductive system (Fig. 4) exhibits the general characters of the genus. The total length of the terminal male genitalia in the figured preparation is 16.0 mm; penis 6.0 mm long (38% of length of male genitalia), penial sheath 3.5 mm long (58% of length of penis); region of penial diverticula adjacent to penial

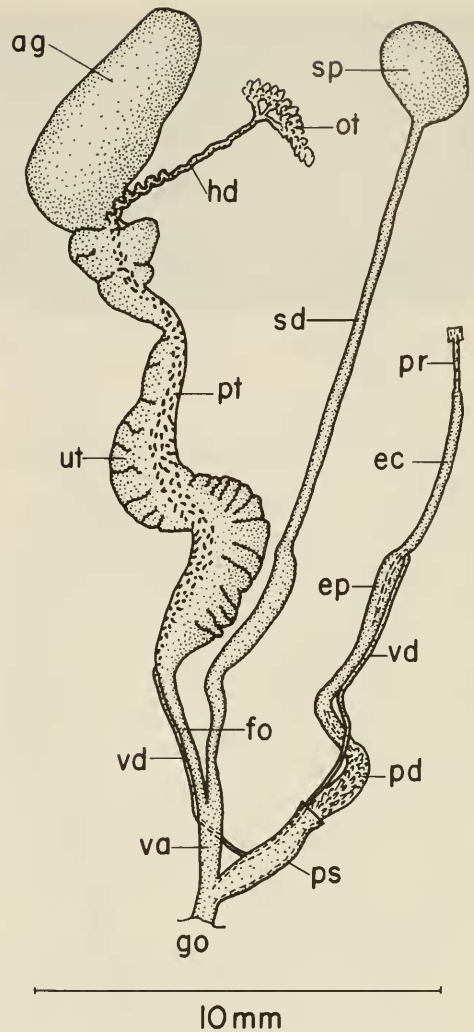


FIGURE 4. *Rabdotus (Plicolumna) perhirsutus* sp. nov., dissected reproductive system, drawn from projection of stained whole mount. Paratype, SBMNH 35111. Abbreviations: ag, albumen gland; ec, epiphallic caecum; ep, epiphallus; fo, free oviduct; go, genital orifice; hd, hermaphroditic duct; ot, ovotestis; pd, upper portion of penis, including diverticula; pr, penial retractor; ps, lower portion of penis, including penial sheath; pt, prostate; sd, spermathecal duct; sp, spermatheca; ut, uterus; va, vagina; vd, vas deferens.

sheath, its diameter about equal to that of sheath and about twice that of epiphallus; epiphallus 6.0 mm long (38% of length of male genitalia); epiphallic caecum 4.0 mm long (25% of length of male genitalia); spermathecal duct 19 mm long with a 4-mm length of the duct commencing about 4 mm from its anterior end, enlarged to



FIGURES 5–7. *Greggelix (Martirelix) huertai* sp. nov., shell. Holotype, SBMNH 35113, top, apertural, and basal views. Diameter 17.8 mm.

almost twice the diameter of the rest of the duct; spermatheca ovate; free oviduct cylindrical, not enlarged.

TYPE MATERIAL.—Holotype, SBMNH 35110 (shell); Mexico, Baja California Sur; along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, in granite rockpiles at crest of small hill seaward of road, elev. ca. 1,500 ft [460 m]; C. C. Christensen, J. A. Christensen, and W. B. Miller, coll., 22 Dec. 1973. One paratype (shell and whole mount of stained genitalia), SBMNH 35111, from same locality as holotype, W. B. Miller and W. N. Miller, coll., 23 Dec. 1970. Fifteen paratypes, SBMNH 35112, from same locality as holotype. Additional paratypes are deposited in ANSP, CAS, LACM, SDMNH, USNM, and the private collections of authors Christensen and Roth.

REFERRED MATERIAL.—Arroyo Candelaria, 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, coll., 21 Dec. 1975 (CCC) (one shell).

REMARKS.—In the material examined, shell height ranges from 18.7 to 21.2 mm; diameter, 4.9 to 6.8 mm; height/diameter ratio 2.88 to 4.16. Number of whorls ranges from 7.6 to 8.5.

The extremely long periostracal hairs of *Rabdotus (Plicolumna) perhirsutus* distinguish it from all other members of the genus. Decorticated shells somewhat resemble *Rabdotus (Plicolumna) artemisia* (Binney, 1861) but can be distinguished from that species by their more strongly carinate embryonic whorls, stronger sculpture, more convex whorls, and more deeply impressed sutures of the postnuclear shell.

Rabdotus (Plicolumna) perhirsutus has been collected at only two localities, both near the southern tip of Baja California. The type locality

is a relatively arid location, and the vegetation consists of thorn scrub and organpipe cactus. The outcrop in which the shells were found is partly shaded by overhanging trees. Despite repeated efforts to collect living specimens for dissection, only a single living individual was found here. A single broken shell was found a short distance to the north, in a shallow talus slide on the southern slope of Arroyo Candelaria, east of Migriño. The vegetation here is similar to that at the type locality.

ETYMOLOGY.—*L.*, *per*, very, + *hirsutus*, hairy.

Family HELMINTHOGLYPTIDAE

Genus *Greggelix* Miller, 1972

TYPE SPECIES: *Greggelix indigena* (Mabille) (= *Helix indigena* Mabille, 1895), by original designation.

Subgenus *Martirelix* Miller, 1982

TYPE SPECIES: *Greggelix (Martirelix) babrakzai* Miller, 1982, by original designation.

Greggelix (Martirelix) huertai Miller and Roth, sp. nov.

(Figs. 5–8)

DIAGNOSIS.—A *Greggelix (Martirelix)* with shell similar to *G. (M.) babrakzai* but differing in the short, broadly conical verge and tapering summit of the penis; with one vestigial mucus gland inserted on the vagina.

DESCRIPTION OF SHELL OF HOLOTYPE.—Shell (Figs. 5–7) of medium size for the genus, rather solid, depressed-helicoid, umbilicate; umbilicus contained 6.6 times in diameter. Whorls well rounded, slightly shouldered; suture well impressed; spire broadly conic; apical angle 135°.

Embryonic whorls 1.2, with irregular, radiating rugae somewhat broken up into granules (particularly on first half whorl), and a few widely spaced, discrete, dotlike papillae in diagonally descending series. Sculpture of early teleoconch whorls consisting of irregular collabral rugae, strongest below suture, and an overall pattern of minute punctations. Punctations variable in prominence, strongest on shoulder of whorl, generally round but from third whorl on sometimes elongated in direction of spiral growth. Base inflated, crossed by growth rugae, with scattered punctations extending to umbilical region. Last 0.2 of body whorl descending sharply to aperture; growth rugae crowded and somewhat granulose behind lip. Aperture ovate, little interrupted by body whorl, ends of peritreme converging. Peristome at angle of 45° to vertical. Lip broadly expanded and reflected; inner lip encroaching but slightly on umbilicus. Parietal callus very thin, granular, free edge sinuous. Shell with waxy luster, light reddish tan, darker on shoulder and lighter around umbilicus, with a 1-mm-wide russet spiral band prolonging trajectory of suture, with traces of lighter zones above and (more distinctly) below the band. Diameter 17.8 mm; height 11.2 mm; diameter of umbilicus 2.7 mm; 4.7 whorls.

REPRODUCTIVE ANATOMY OF HOLOTYPE.—The reproductive system (Fig. 8) exhibits the general characters of the genus, namely exceptionally long spermathecal diverticulum and epiphallic caecum, no dart apparatus, and a small verge in the saccular penis. The verge is short and broadly conical, with a pointed tip. The saccular penis is also conical, being widest at the base of the verge. The summit of the penis tapers rapidly to the slender epiphallus. A single, vestigial mucus gland is inserted near the middle of the vagina.

TYPE MATERIAL.—Holotype, SBMNH 35113 (shell and whole mount of stained genitalia); Mexico, Baja California: Cerro de la Mina de San Juan, Sierra La Libertad, in rockpiles on north side of entrance to the mine; 28°42.5'N, 113°34.7'W, elev. ca. 1,300 m; W. B. Miller, C. Huerta, and students of University of Arizona 1981 General Biology 580 class, coll.; 26 Nov. 1981. Ten paratypes (shells), SBMNH 35114, from same locality as holotype. Additional paratypes are deposited in ANSP, CAS, USNM, and the private collection of author Roth.

REMARKS.—The type lot consists of the ho-

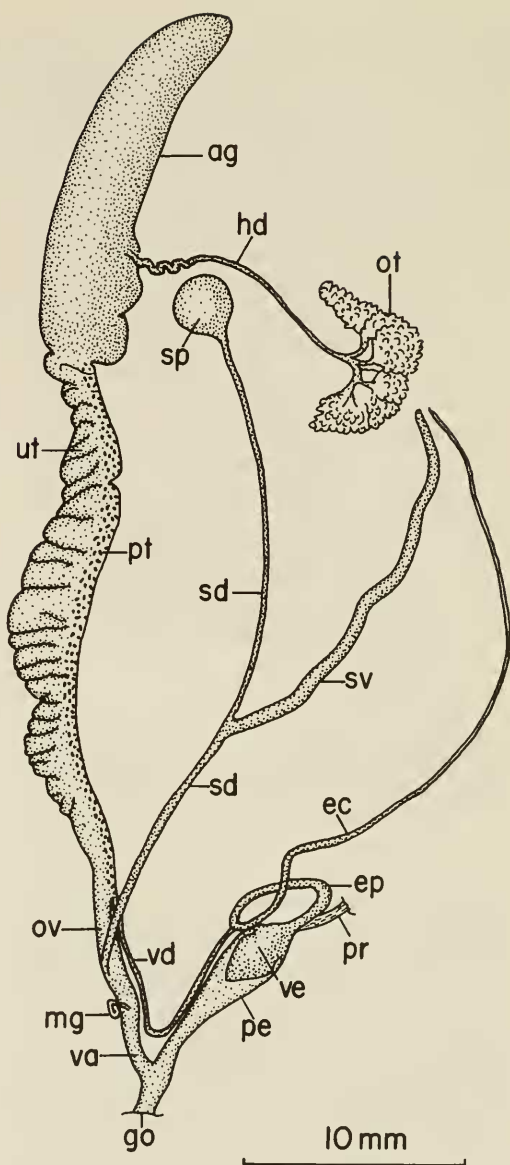


FIGURE 8. *Greggelix (Martirelix) huertai* sp. nov., dissected reproductive system, drawn from projection of stained whole mount. Holotype, SBMNH 35113. Abbreviations: ag, albumen gland; ec, epiphallic caecum; ep, epiphallus; go, genital orifice; hd, hermaphroditic duct; mg, mucus gland; ot, ovotestis; ov, oviduct; pe, penis; pr, penial retractor; pt, prostate; sd, spermathecal duct; sp, spermatheca; sv, spermathecal diverticulum; ut, uterus; va, vagina; vd, vas deferens; ve, verge.

lotype and 29 adult paratypes. Maximum diameter ranges from 16.7 to 21.5 mm (mean, 18.52 mm); height, 9.7 to 13.1 mm (\bar{x} = 11.27 mm); height/diameter ratio 0.56 to 0.68 (\bar{x} = 0.609).

Only two specimens were found alive—the holotype, which was adult, and an immature individual that died in a terrarium before reaching maturity. Accordingly, no data are available on variation in anatomical characters such as the frequency of the presence of one, two, or (as in *G. babrakzaii*) no vestigial mucus glands.

The reproductive anatomy of *Greggelix (Martirelix) huertai* resembles that of *G. (M.) babrakzaii*, which inhabits the lower elevations of the arid eastern canyons of the Sierra San Pedro Mártir some 300 km to the northwest. It differs, however, in the size and shape of the verge, which is short, wide, and conical. The length of the verge is approximately the same (2.5 mm) as in *G. babrakzaii*, but its diameter is more than twice as large at the base (2.2 mm), decreasing rapidly to a sharp conic tip. In *G. babrakzaii* the narrower verge (diameter 1.0 mm) remains cylindrical to the blunt paraboloid tip. Additionally, the penis in *G. babrakzaii* is sharply truncate where it joins the epiphallus, whereas in *G. huertai* it is broadly conic.

The habitat of *Greggelix (Martirelix) huertai* is within the Vizcaino Desert zone (=sarcophyllous desert, =*Agave-Franseria* region of Shreve [1951]; see section on biogeography, below). The habitat of *G. babrakzaii* is in the Colorado Desert zone (=microphyllous desert, =*Larrea-Franseria* region). Whereas *G. babrakzaii* was found principally under boulders and rockpiles along the riparian lower slopes of canyons such as Cañon el Diablo and Cañon Diablito, *G. huertai* was found only high on the xeric north slope of the Cerro de la Mina de San Juan. It was not found in the lower slopes along Cañada San Juan, which leads west to Rancho San Gregorio, nor in the deep ravines that lead east to El Terminal and Valle Las Flores. The vegetation in the immediate vicinity of the type locality consists mainly of *Idria columnaris*, *Xylococcus bicolor*, *Quercus ajoensis*, *Heteromeles arbutifolia*, *Rhus laurina*, *Dodonea viscosa*, *Simmondsia chinensis*, *Adenostoma fasciatum*, and *Agave deserti*. *Greggelix huertai* has not been reported from any locality other than the type locality.

ETYMOLOGY.—The species is named after Dr. Carlos Huerta, author Miller's former biology student and an enthusiastic member of the expedition to the Cerro de la Mina de San Juan, who found the only live adult snail, thereby providing the means to identify the species.

DISTRIBUTIONAL LIST OF LAND MOLLUSCA OF BAJA CALIFORNIA

CONVENTIONS.—The classification at the family level and above is modified slightly from that of Solem (1978), with the addition of the family Thysanophoridae and use of the -oidea suffix for superfamily names as recommended by the International Code of Zoological Nomenclature. Place names are for the most part standardized according to Gerhard and Gulick (1970) except where quoted directly from original sources. The type locality of a taxon is indicated by "TL." To distinguish the state of Baja California (Estado de Baja California) from the peninsula itself, the expression "Baja California Norte" is used for the former. Extralimital distribution of taxa occurring outside of Baja California is given in summary form.

Institutional and private collections are abbreviated as follows: AMNH—American Museum of Natural History; ANSP—Academy of Natural Sciences, Philadelphia; BR—Barry Roth, San Francisco, California; CAS—California Academy of Sciences; CCC—Carl C. Christensen, Honolulu, Hawaii; LACM—Los Angeles County Museum of Natural History; MCZ—Museum of Comparative Zoology, Harvard University; MNHN—Muséum National d'Histoire Naturelle, Paris; RLR—Richard L. Reeder, Tulsa, Oklahoma; SBMNH—Santa Barbara Museum of Natural History; SDMNH—San Diego Museum of Natural History; UA—Department of Ecology and Evolutionary Biology, University of Arizona, Tucson; USNM—United States National Museum of Natural History; WBM—Walter B. Miller, Tucson, Arizona.

Class GASTROPODA Subclass PROSOBRANCHIA Superorder MESOGASTROPODA Superfamily RISSOIDEA Family TRUNCATELLIDAE Genus *Truncatella* Risso, 1826

Truncatella californica Pfeiffer, 1857

SYNONYMS.—*Truncatella gracilentia* 'Gould,' Binney, 1858 (nomen nudum). *Truncatella stimpsoni* Stearns, 1872. *Pseudosubulina ruthae* Pilsbry, 1954.

DISTRIBUTION.—Southern California (Santa Barbara; McLean 1978) to the upper Gulf of California (Taylor in Keen 1971). BAJA CALIFORNIA NORTE: Estero S of Ensenada, along road to Punta Banda, under rocks at water's edge, W. B.

Miller, 1 Jan. 1957 (WBM). Isla San Martín, F. Baker, Aug. 1899 (F. Baker 1902; Pilsbry 1927). Isla San Gerónimo (Lowe 1913). Santo Domingo (Orcutt 1900a, 1915).

Snails of this genus are amphibious and live among stones and debris near the high-tide mark. *Truncatella californica* varies in sculpture from strongly ribbed to nearly smooth. McLean (1978) referred to *T. stimpsoni* as the smooth variant, but that name was founded on strongly ribbed individuals. *Pseudosubulina ruthae* (new synonymy herein) was based on the early whorls of *T. californica*, as confirmed by examination of the holotype and paratypes (ANSP 190114).

Truncatella guadalupensis Pilsbry, 1901

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe (TL), R. E. Snodgrass, Nov. 1899 (Pilsbry 1901, 1927; ANSP). Late Pleistocene, Discovery Point Formation, Isla Guadalupe (Lindberg et al. 1980) (SDMNH).

Subclass PULMONATA
Superorder STYLOMMATOPHORA
Order ORTHURETHRA
Superfamily PUPILLOIDEA
Family PUPILLIDAE

Genus *Gastrocopta* Wollaston, 1878
Subgenus *Gastrocopta* sensu stricto

Gastrocopta (Gastrocopta) pellucida hordeacella (Pilsbry, 1890)

(Fig. 9)

SYNONYM.—*Bifidaria hordeacella* var. *parvidens* Sterki, 1899.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Along Transpeninsular Highway 5.0 mi [8.0 km] SE of road to San Ignacio, C. C. Christensen, W. B. Miller, 4 Dec. 1974 (CCC). Gulf slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta to Guajaderní, in rockslide along trail ca. 1 mi [1.6 km] from Pie de la Cueta, elev. ca. 2,100 ft [640 m], C. C. Christensen, W. B. Miller et al., 22 Oct. 1972 (CCC). Guajaderní (Pilsbry 1916–1918, 1948). La Purísima, W. B. Miller, 1970 (Bequaert and Miller 1973, as *G. procera*; WBM). W of San Miguel Comondú, R. J. Drake, 1953 (UA). San José Comondú, R. J. Drake, 1953 (CAS). San Javier, C. C. Christensen, W. B. Miller, 28 May 1975 (CCC). San Javier, in rockslide across stream from mission, elev. 1,200–1,500 ft [370–460 m], C. C. Christensen, W. B. Miller et al., 25 Oct. 1972 (CCC). In lava rockslide a short distance up arroyo immediately S of San Juánico, C. C. Christensen, W. B. Miller, 28 May 1975 (CCC). Along Transpeninsular Highway at km 69 N of Villa Insurgentes, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC). Juncalito, C. C. Christensen, 30 July 1974 (CCC). Arroyo Candelaria 4.2 mi [6.8 km] E of Migriño and 2.1 mi [3.4 km] W of Candelaria, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along Santa Catarina–Los Frailes road 13.5 mi [21.7 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC); and

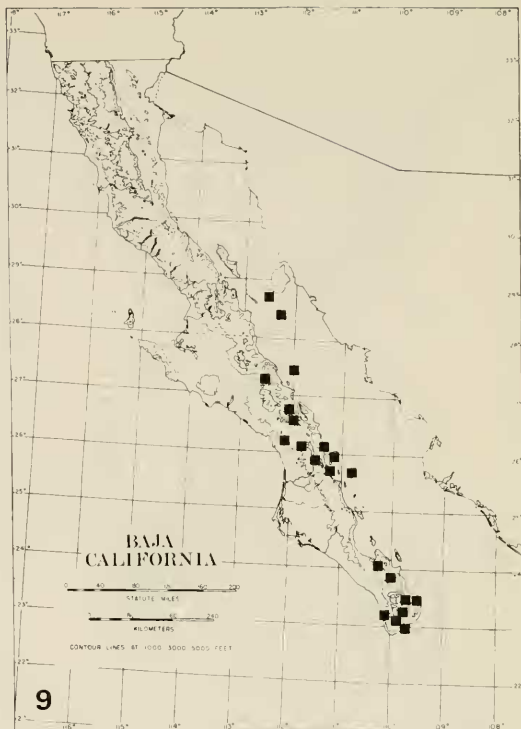


FIGURE 9. Distribution in Baja California of *Gastrocopta pellucida hordeacella*. In this and subsequent maps, each symbol represents one or more localities.

13.5 mi [21.6 km] NE of Santa Catarina, elev. 1,200 ft [370 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC). Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Ca. 1–1.5 mi [1.6–2.4 km] W of Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Many localities in Cape region from vicinity of La Paz to San José del Cabo, in stream drift, A. E. Leviton, A. G. Smith, I. L. Wiggins, CAS 1958–1959 Exped. (CAS). Along Todos Santos–Cabo San Lucas road 2.1 mi [3.4 km] N of El Saucito, elev. 1,500 ft [460 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Isla Coronados, C. C. Christensen, 1 Aug. 1974 (CCC). Isla Carmen, G. D. Hanna et al., 1953 ORCA Exped. (CAS). Isla Danzante, P. Turk, Jan. 1978 (CCC). Isla Santa Catalina, G. D. Hanna et al., 1953 ORCA Exped. (CAS). Isla Tortuga, CAS 1921 Exped. (Hanna 1923, as *G. p. parvidens*; CAS). SONORA: Isla San Esteban, G. D. Hanna et al., 1953 ORCA Exped. (CAS). Isla San Pedro Mártir, G. D. Hanna et al., 1953 ORCA Exped. (CAS).

This species is most commonly found in litter on rocky slopes or beneath vegetation. It will probably be found to occur on other Gulf islands and on the peninsula in the state of Baja California (Norte) when the minute snails of those areas are adequately known. Elsewhere, the range

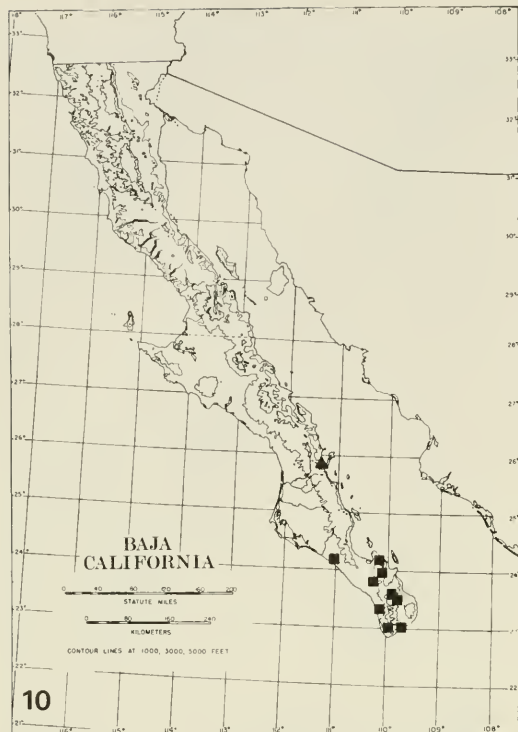


FIGURE 10. Distribution of *Gastrocopta allyni* (squares) and *Gastrocopta* sp., cf. *G. riograndensis* (triangle).

of *G. p. hordeacella* extends from southern California, Arizona, and New Mexico eastward to Florida and, in a narrow strip along the Atlantic coast, north to New Jersey. On the mainland of North and Central America this subspecies occurs as far south as Nicaragua. It occurs on Islas Clarión and Socorro of the Revillagigedos group (Dall 1900). In the West Indies it is replaced by the nominate race of the species (Pilsbry 1948; Bequaert and Miller 1973).

We concur with the opinions of Branson et al. (1966) and Bequaert and Miller (1973) that *Gastrocopta pellucida parvidens* (Sterki) is not separable from other west American representatives of the species. We retain the name *G. p. hordeacella* for mainland populations of this species, but note that comparison with West Indian material may result in its union with the nominate subspecies.

The specimen from La Purísima reported by Bequaert and Miller (1973:171) as *Gastrocopta procera* (Gould) is here redetermined as *G. p. hordeacella*.

***Gastrocopta (Gastrocopta) sp.*, cf. *G. (G.) riograndensis* (Pilsbry and Vanatta, 1900)**

(Fig. 10)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Juncalito, C. C. Christensen, 30 July 1974 (CCC).

Gastrocopta riograndensis occurs from Texas to northeastern Mexico (Pilsbry 1916–1918, 1948; Neck 1980). The apertural teeth of the two specimens from Juncalito are the same as in Texan specimens described by Pilsbry (1948), but the specimens lack a crest behind the aperture.

**Subgenus *Immersidens*
Pilsbry and Vanatta, 1900**

***Gastrocopta (Immersidens) allyni* Roth and Christensen, 1984**

(Fig. 10)

DISTRIBUTION.—BAJA CALIFORNIA SUR: 0.4 mi [0.6 km] N of km 105 along Transpeninsular Highway N of La Paz, C. C. Christensen, W. B. Miller, 6 Dec. 1974 (CCC). Arroyo de los Pozos, 12.9 mi [20.6 km] E of La Paz, on road to Las Cruces, A. G. Smith, CAS 1958–1959 Exped. (CAS). Sierra Cacachila, 9.8 mi [15.7 km] E of La Paz–Cabo San Lucas highway, elev. 1,400 ft [420 m], C. C. Christensen, J. A. Christensen, 18 Dec. 1975 (CCC). Arroyo ca. 15 mi [24 km] S of La Paz, in drift (TL), A. G. Smith, 2 Nov. 1959 (CAS, CCC). Km 5000.2 S of San Antonio, in leafmold, A. G. Smith, CAS 1958–1959 Exped. (CAS). San Bartolo, W. B. Miller, Dec. 1970 (UA). 5.3 mi [8.5 km] NW of Todos Santos along road to La Pastora, A. G. Smith, CAS 1958–1959 Exped. (CAS). Along road to La Burrera, 7.0 mi [11.2 km] from Cabo San Lucas–Todos Santos road, elev. 1,000 ft [300 m], C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Bahía San Pedrito, 3.9 mi [6.2 km] SE of Todos Santos, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS). 0.2 mi [0.3 km] SSE of San José del Cabo on road to La Playa, stream drift, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS). Along road from Cabo San Lucas to Todos Santos, 2.2 mi [3.5 km] N of El Saucito, in granite outcrops W of road, elev. 1,500 ft [450 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1973; C. C. Christensen, 9 Aug. 1974 (CCC). Along road from Cabo San Lucas to Todos Santos, 2.1 mi [3.4 km] N of El Saucito, elev. 1,500 ft [450 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC).

***Gastrocopta (Immersidens) rixfordi* Hanna, 1923**

(Fig. 11)

DISTRIBUTION.—BAJA CALIFORNIA SUR: San Ignacio, elev. 500 ft [150 m], W. B. Miller (Bequaert and Miller 1973, as *Gastrocopta dalliana dalliana*; UA). Along Transpeninsular Highway 5.0 mi [8.0 km] SE of road to San Ignacio, C. C. Christensen, W. B. Miller, 4 Dec. 1974 (CCC). San Javier, in rockslides S of the mission, W. B. Miller, 24 Oct. 1971 (UA, CCC). San José Comondú, elev. 1,500 ft [450 m], W. B. Miller, 20 Dec. 1970 (Bequaert and Miller 1973, as *G. d. dalliana*; UA). Along Transpeninsular Highway at km 69 (42.9 mi) N of Villa Insurgentes, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC). 0.4 mi [0.6 km] N of km 105 along Transpen-

insular Highway N of La Paz, C. C. Christensen, W. B. Miller, 6 Dec. 1974 (CCC). Arroyo E of Transpeninsular Highway at km 77 N of La Paz, C. C. Christensen, W. B. Miller, 6 Dec. 1974 (CCC). Sierra Cacachila, along La Paz–Los Planes road, 9.8 mi [15.7 km] E of La Paz–Cabo San Lucas Highway, elev. 1,400 ft [420 m], C. C. Christensen, J. A. Christensen, 18 Dec. 1975 (CCC). San Bartolo, elev. 500 ft [150 m], W. B. Miller, 28 Dec. 1970 (Bequaert and Miller 1973, as *G. d. dalliana*; UA). Along road from Todos Santos to Cabo San Lucas, 0.8 mi [1.3 km] S of Las Barrancas (and 15.8 km S of Las Piedritas), C. C. Christensen, J. A. Christensen, 25 Dec. 1975 (CCC). Arroyo Candelaria at Migriño, C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Isla Monserrate (TL), J. C. Chamberlin, 25 May 1921, CAS 1921 Exped. (Hanna 1923; CAS). Isla Danzante, P. Turk, Jan. 1978 (CCC).

The specimens from the peninsula reported by Bequaert and Miller (1973) as *Gastrocopta dalliana dalliana* (Sterki, 1898) prove on re-examination to be *G. rixfordi*, described from Isla Monserrate. In *G. d. dalliana* the aperture is smaller, the columellar lamella emerges farther on the inner lip, and the angular and parietal lamellae are smaller and closer together than in *G. rixfordi*. Hanna (1923) originally assigned *G. rixfordi* to the subgenus *Albinula* Sterki, 1892, but the apertural dentition is that of *Immersi-dens*.

Genus **Pupilla** Leach in Fleming, 1828
Subgenus **Pupilla** sensu stricto

Pupilla (Pupilla) hebes (Ancey, 1881)

(Fig. 11)

SYNONYMS.—*Pupilla hebes nefas* Pilsbry and Ferriss, 1910. *Pupilla hebes kaibabensis* Pilsbry and Ferriss, 1911. *Pupilla muscorum idahoensis* Henderson and Daniels, 1917. *Pupilla hebes mutant albescens* Ferriss, 1920.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Sierra San Pedro Mártir, in rockslide above road 1.4 mi [2.2 km] below astronomical observatory, elev. ca. 8,800–9,000 ft [2,700–2,800 m], C. C. Christensen, 3 Nov. 1973 (CCC). Sierra San Pedro Mártir, in rockslide in ravine above road 0.8 mi [1.3 km] below astronomical observatory, elev. ca. 8,800–9,000 ft [2,700–2,800 m], C. C. Christensen, 3 Nov. 1973 (Miller 1981a; CCC).

Pupilla hebes is widely distributed in the western United States and has also been reported from the state of Chihuahua, Mexico (Pilsbry 1948, 1953). At high elevations in the Sierra San Pedro Mártir, it has been found living in the region of *Pseudotsuga* forest. All specimens found are sinistral.

Subgenus **Striopupilla** Pilsbry, 1921

Pupilla (Striopupilla) sterki (Pilsbry, 1890)

(Fig. 11)

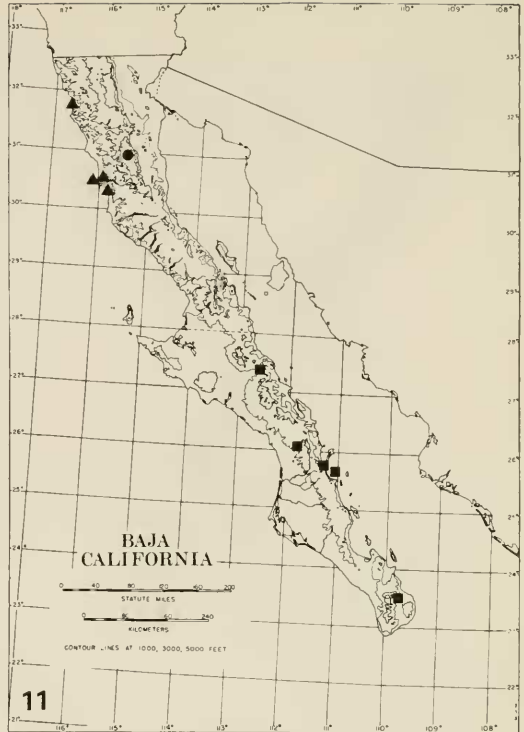


FIGURE 11. Distribution of *Gastrocopta rixfordi* (squares), *Pupilla hebes* (circle), and *Pupilla sterki* (triangles).

DISTRIBUTION.—Lower California (TL), C. R. Orcutt (Pilsbry 1890a, b; ANSP). BAJA CALIFORNIA NORTE: On lichen, along the ocean beach N and S of Bahía San Quintín (Orcutt 1886, as *Pupa chordata*; 1891). Under lichen, *Ramalina homalea*, W coast of San Quintín peninsula, W of Winston Hill, S. S. Berry, 25 Mar. 1949 (SBMNH). San Ramón (Pilsbry 1920–1921). Isla San Martín, G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS). Ensenada, under succulents on hillside S of city, W. B. Miller, 16 Oct. 1955 (WBM).

The exact type locality is uncertain. Pilsbry (1920–1921) cited specimens collected at San Ramón (on the Pacific coast near Colonia Guerrero) by C. R. Orcutt, but did not identify them as types.

Pupilla (Striopupilla) goniodon Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, Northeast Anchorage, elev. not greater than 100 ft [30 m] in the canyon back of the buildings (TL), G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH). Isla San Benito del Oeste, on dried lower leaves of *Dudleya*, G. E. Lindsay, 5 Feb. 1950 (SBMNH); empty shells in litter from under rocks and agave plants, C. C. Christensen, W. B. Miller, 10 May 1975 (CAS).



FIGURE 12. Distribution of *Pupoides albilabris* (squares) and *Pupoides catalinensis* (triangle).

The SBMNH collection contains one specimen of *P. (S.)* sp., cf. *P. (S.) goniodon* from a lower human occupation level in an old dune at Punta Baja (C. L. Hubbs coll.); the species has not been found living on the mainland.

Pupilla (Striopupilla) guadalupensis Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, elev. 1,000 ft [300 m] above Northeast Anchorage (TL); near sea level at Northeast Anchorage; 2 mi [3.2 km] N of S end of island on E side; and crest of Pine Ridge at elev. 3,000 ft [900 m], G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH).

Genus *Pupoides* Pfeiffer, 1854

Pupoides albilabris (C. B. Adams, 1841)

(Fig. 12)

SYNONYMS.—*Cyclostoma marginata* Say, 1821 (non *C. marginatum* G. Fischer, 1807). *Bulinus nitidulus* Pfeiffer, 1839 (non Beck, 1837). *Pupa modica* Gould, 1848. *Pupa (Modicella) arizonensis* Gabb, 1866.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Ángel de la Guarda, CAS 1921 Exped. (Hanna 1923, as *P. marginatus*; CAS). Isla San Lorenzo, CAS 1921 Exped. (Hanna 1923, as *P. marginatus*; CAS). BAJA CALIFORNIA SUR: Bahía de

la Concepción, G D. Hanna, R. L. Bolin, 1953 ORCA Exped. (CAS). Gulf slope of Sierra de la Giganta, SW of Mulegé; trail from Pie de la Cueta (2.9 mi S of El Potrero) to Guajaderní (ca. 1 mi from Pie de la Cueta ranch), W. B. Miller, 22 Oct. 1972 (UA). San José Comondú, elev. 1,500 ft [460 m], W. B. Miller, 20 Dec. 1970 (Bequaert and Miller 1973). San Ignacio, elev. 500 ft [150 m], W. B. Miller, 13 Dec. 1970 (Bequaert and Miller 1973; UA). Along Transpeninsular Highway 5.0 mi [8.0 km] SE of access road to San Ignacio, in rockslide by road, C. C. Christensen, W. B. Miller, 4 Dec. 1974 (CCC). Transpeninsular Highway at km 77 N of La Paz, ca. 0.75 mi [1.2 km] E of road in arroyo, among rocks, C. C. Christensen, W. B. Miller, 6 Dec. 1974 (CCC). Boca de la Sierra, 1.0–1.5 mi [1.6–2.4 km] upstream of village, among granite rocks on S slope, near stream, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Arroyo S of San Juánico and Punta Pequeña, in litter of lava rockslide, C. C. Christensen, W. B. Miller, 28 May 1975 (CCC). Many localities in Cape region from vicinity of La Paz to San José del Cabo, in stream drift, A. E. Leviton, A. G. Smith, I. L. Wiggins, CAS 1958–1959 Exped. (CAS). Along road from Todos Santos to Cabo San Lucas, 3.1 mi [5.0 km] S of Las Piedritas (and ca. 19.8 mi S of Todos Santos), C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along road from Todos Santos to Cabo San Lucas, 0.8 mi [1.3 km] S of Los Barrancos (and 9.3 mi S of Las Piedritas), C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Isla Coronados (larger island), in litter, rockslide S of peak, C. C. Christensen, 1 Aug. 1974 (CCC). Isla Carmen, Bahía Marquer, W. K. Emerson, 4–5 Apr. 1962, Belvedere Exped. (Emerson and Jacobson 1964). Isla Danzante, P. Turk, Jan. 1978 (CCC). Isla Tortuga, CAS 1921 Exped. (Hanna 1923, as *P. marginatus*; CAS). Isla Monserrate, CAS 1921 Exped. (Hanna 1923, as *P. marginatus*; CAS). SONORA: Isla San Esteban, CAS 1921 Exped. (Hanna 1923, as *P. marginatus*; CAS).

Pupoides albilabris is widely distributed in North America; subspecies occur in the West Indies and South America (Bequaert and Miller 1973).

Pupoides catalinensis Hanna, 1923

(Fig. 12)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Santa Catalina (TL), J. C. Chamberlin, CAS 1921 Exped. (Hanna 1923; CAS, SBMNH); G D. Hanna, 1953 ORCA Exped. (CAS). E side of Isla Santa Catalina, W. K. Emerson, 10 Apr. 1962, Belvedere Exped. (Emerson and Jacobson 1964).

Genus *Vertigo* Müller, 1774 Subgenus *Vertigo* sensu stricto

Vertigo (Vertigo) berryi Pilsbry, 1919

(Fig. 13)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Valle Trinidad, C. R. Orcutt, 1901 (Pilsbry 1948). Cañon Cantiles, C. R. Orcutt, 2 Aug. 1883 (SBMNH).

This species also occurs in the San Bernardino Mountains of southern California (Pilsbry 1948), the Spring Range, Nevada (Pratt 1976), and Pleistocene deposits in Arizona (Bequaert and

Miller 1973), Nevada (Taylor 1967), and California (Hewett 1956).

Vertigo (Vertigo) ovata Say, 1822

(Fig. 13)

SYNONYMS.—*Zonites upsoni* Calkins, 1880. *Pupa ovata* f. *antiquorum* Cockerell, 1891.

DISTRIBUTION.—BAJA CALIFORNIA SUR: 0.2 mi [0.3 km] SSE of San José del Cabo, on the road to La Playa, in stream drift, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS), Sierra Laguna, G. Eisen, 1892 (Cooper 1892b).

This species is widely distributed in North America, from Alaska and Washington eastward to Labrador and south to Arizona, Texas, Florida, and the West Indies (Pilsbry 1948). The collection of this species in the Cape region by Smith and Leviton confirms the earlier record of Cooper (1892b). This locality is far from other portions of the recorded range of *V. ovata*. Orcutt's (1886) record from north of 31°N has not been confirmed and probably was based on another pupillid species.

Genus *Nearctula* Sterki, 1892

Nearctula rowelli diegoensis (Sterki, 1890)

(Fig. 13)

SYNONYMS.—(?) *Pupa californica* var. *meridionalis* 'Sterki,' Hemphill, 1900 (nomen nudum). *Pupa orcutti* 'Pilsbry,' Orcutt, 1891 (nomen nudum).

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Bahía Todos Santos, C. R. Orcutt (SBMNH). Near Bahía San Quintín, on lichens, C. R. Orcutt, Apr. 1886 (Orcutt 1891, 1896, as *Pupa orcutti*; SBMNH). Bahía San Quintín, W shore, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS). Hills W of Bahía San Quintín, in litter among rocks, C. C. Christensen, 28 Dec. 1975 (CCC). San Ramón, C. R. Orcutt, 1886 (Pilsbry 1918–1920; SBMNH). Isla San Martín, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Nearctula, formerly regarded as a subgenus of *Vertigo*, is here ranked as a genus in accordance with the findings of Coney (1988; pers. comm.). Because of a lectotype designation by Clarke (1960), *Nearctula rowelli* (Newcomb, 1860) is a senior synonym of *Pupa californica* Rowell, 1861, the name formerly used for this species (Roth, in prep.).

Various subspecies of *Nearctula rowelli* occur from the region of San Francisco, California, south to Bahía San Quintín and Isla Guadalupe; *N. r. diegoensis* also occurs in the vicinity of San Diego, California.

Nearctula rowelli catalinaria (Sterki, 1890)

(Fig. 13)



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FIGURE 13. Distribution in Baja California of *Vertigo berry* (circle), *Vertigo ovata* (squares), *Nearctula rowelli diegoensis* (solid triangles), and *Nearctula rowelli catalinaria* (open triangle).

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Sierra San Pedro Mártir, along road to astronomical observatory, in rocks in ravine ca. 1.4 road mi [2.2 km] below observatory housing area, elev. ca. 8,800 ft [2,700 m], C. C. Christensen, W. B. Miller, 3 Nov. 1973 (WBM). Isla Guadalupe, Northeast Anchorage and elev. 1,000 ft [300 m] above; and 2 mi [3.2 km] N of S end of island on E side, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

This subspecies also occurs on the southern California Channel Islands—San Clemente, Santa Catalina, San Nicolas, and Santa Barbara.

Nearctula rowelli guadalupensis (Pilsbry, 1927)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, elev. 1,000 ft [300 m] above landing at Northeast Anchorage (TL), G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Pilsbry (1927) reported that this subspecies occurred sympatrically with *Nearctula rowelli catalinaria* on Isla Guadalupe. Determination of the name(s) applicable to Isla Guadalupe populations of *Nearctula rowelli* must await a review of variation within the species throughout its range.



FIGURE 14. Distribution of *Sterkia calamitosa calamitosa* (open triangles), *Sterkia calamitosa martiniana* (solid triangles), and *Sterkia hemphilli* (squares).

Nearctula degeneris (Pilsbry, 1927)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, elev. ca. 1,000 ft [300 m] above landing at Northeast Anchorage (TL), G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Genus *Sterkia* Pilsbry, 1898 Subgenus *Sterkia* sensu stricto

Sterkia (*Sterkia*) *calamitosa calamitosa* (Pilsbry, 1889)

(Fig. 14)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Near the mouth of San [Santo] Tomás River (TL), H. Hemphill (Pilsbry 1889; ANSP, CAS). Ensenada de Todos Santos, under "*Mesembryanthemum aequilaterale*" (= *Carpobrotus aequilaterus*), C. R. Orcutt, 28 Jan. 1889 (Pilsbry 1948; SBMNH). Hills W of Bahía San Quintín, living snails in litter among rocks, C. C. Christensen, 28 Dec. 1975 (CCC).

Typical specimens of *S. c. calamitosa* occur at Santo Tomás and Ensenada de Todos Santos. Specimens from near San Quintín, on the peninsula adjacent to Isla San Martín, are similar to

specimens of *S. c. martiniana* in size but lack the suprapalatal tubercle said to distinguish that subspecies.

Sterkia (*Sterkia*) *calamitosa martiniana* Pilsbry, 1927

(Fig. 14)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla San Martín (TL), under stones and among plant debris, G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS). Isla San Martín, near Hassler Cove fishing settlement, in litter, C. C. Christensen, W. B. Miller, 12 June 1975 (CCC).

A weakly characterized subspecies, differing from typical *S. calamitosa* in its slightly larger size and the presence in most specimens of a suprapalatal tubercle.

Sterkia (*Sterkia*) *hemphilli* (Sterki, 1890)

(Fig. 14)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Banks of St. Thomas [Santo Tomás] River (TL), H. Hemphill (Sterki 1890; ANSP). Ensenada de Todos Santos, under decaying "*Mesembryanthemum aequilaterale*" (= *Carpobrotus aequilaterus*), C. R. Orcutt (Pilsbry 1920–1921, 1948; SBMNH). Bahía San Quintín, W shore, G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS). Punta Abreojos, H. Hemphill (Pilsbry 1920–1921, 1948; USNM).

Sterkia hemphilli also occurs in San Luis Obispo, San Bernardino, and San Diego counties, California (Pilsbry 1948; Roth 1973).

Subgenus *Metasterkia* Pilsbry, 1920

Sterkia (*Metasterkia*) *clementina* (Sterki, 1890)

SYNONYM.—*Bifidaria clementina oldroydi* Vanatta, 1910.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, Northeast Anchorage, G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Sterkia clementina has been reported from San Clemente and Santa Barbara islands, California. We now report its occurrence on San Nicolas Island, California, collected by W. B. Miller, 22 May 1954 and 31 Aug. 1958 (WBM), and by D. R. Lindberg and M. G. Kellogg, 12 June 1980 (BR).

Family VALLONIIDAE Genus *Vallonia* Risso, 1826

Vallonia cyclophorella Sterki, 1892

(Fig. 15)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Sierra San Pedro Mártir, elev. 8,800–9,000 ft [2,700–2,800 m], W. B. Miller, C. C. Christensen, Nov. 1973 (Miller 1981a).

Vallonia cyclophorella is widely distributed in the western United States (Pilsbry 1948).

Family STROBILOPSIDAE
Genus *Strobilops* Pilsbry, 1893

Strobilops californica Miller and Christensen, 1980

(Fig. 15)

DISTRIBUTION.—BAJA CALIFORNIA SUR: La Laguna, Sierra de la Victoria, along slope above creek immediately behind La Laguna shelter, elev. ca. 6,500 ft [1,980 m] (TL), W. B. Miller, C. C. Christensen, 31 Dec. 1973 (Miller and Christensen 1980; USNM).

Known from a single empty shell found high in the mountains of the Cape region.

Order SIGMURETHRA
Suborder HOLOPODOSES
Superfamily ACHATINOIDEA
Family SUBULINIDAE

Genus *Lamellaxis* Strebel and Pfeffer, 1882

Lamellaxis gracilis (Hutton, 1834)

SYNONYMS.—*Achatina subula* Pfeiffer, 1839. *Bulimus octonoides* Orbigny, 1841. *Bulimus oparanus* Pfeiffer, 1846.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Arroyo 15 mi [24 km] S of La Paz, a nuclear tip in stream drift, A. G. Smith, CAS 1958–1959 Exped. (CAS). Bahía San Pedrito, 3.9 mi [6.3 km] SE of Todos Santos, A. G. Smith, CAS 1958–1959 Exped. (CAS). Eastern outskirts of San José del Cabo, along an irrigation ditch, I. L. Wiggins, CAS 1958–1959 Exped. (CAS). In stream drift 0.2 mi [0.3 km] SSE of San José del Cabo, on road to La Playa, A. E. Leviton, A. G. Smith, CAS 1958–1959 Exped. (CAS).

Lamellaxis gracilis has been dispersed by commerce throughout the tropical and warm-temperate regions of the world. Pilsbry (1940) believed it indigenous to tropical America, but its presence on the islands of the southwestern Pacific about 2,900 yr ago (Christensen and Kirch 1981) suggests that an Old World origin is equally plausible. It is doubtlessly an introduction to Baja California.

Genus *Opeas* Albers, 1850

Opeas pumilum (Pfeiffer, 1840)

SYNONYM.—*Helix goodalli* Miller, 1822 (non Férussac, 1821).

DISTRIBUTION.—BAJA CALIFORNIA SUR: Bahía San Pedrito, 3.9 mi [6.3 km] SE of Todos Santos, A. G. Smith, CAS 1958–1959 Exped. (CAS).

This introduced species has been widely distributed by commerce in many parts of the world.

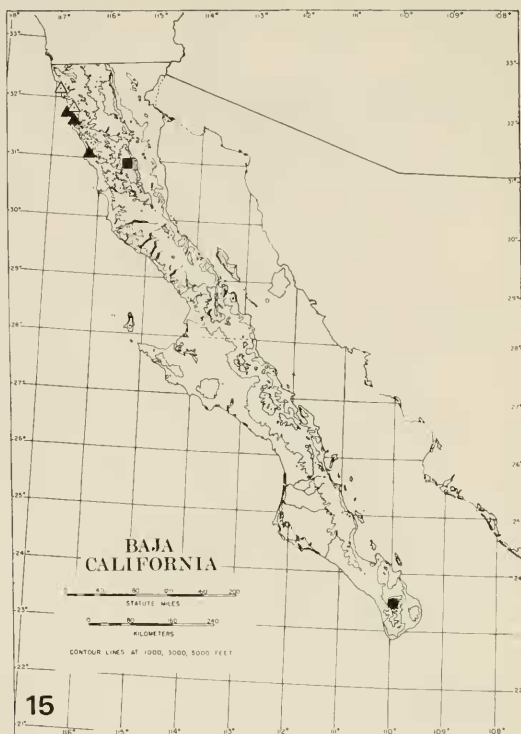


FIGURE 15. Distribution of *Vallonia cyclophorella* (square), *Strobilops californica* (circle), *Haplotrema caelatum* (solid triangles), and *Haplotrema transfuga* (open triangles).

Superfamily RHYTIDOIDEA
Family HAPLOTREMATIDAE
Genus *Haplotrema* Ancey, 1881
Subgenus *Haplotrema* sensu stricto

Haplotrema (Haplotrema) guadalupense Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, Pine Ridge, elev. ca. 3,000 ft [900 m] (TL), G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Haplotrema (Haplotrema) transfuga (Hemphill, 1892)

(Fig. 15)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Bahía Todos Santos, H. Hemphill (Binney 1892). Rockslide near San Diego–Ensenada Highway, La Misión Valley, ca. 40 mi [64 km] S of Tijuana, E. P. and E. M. Chace, G. Willett, 1937 (Chace 1937). La Misión Valley, W. O. Gregg, 20 Apr. 1940, 10 Dec. 1947 (H. B. Baker 1941b; LACM). La Misión Valley, along Transpeninsular Highway, in rockslide on S side of valley, seaward side of bridge, W. B. Miller, 14 Feb. 1959 (WBM).

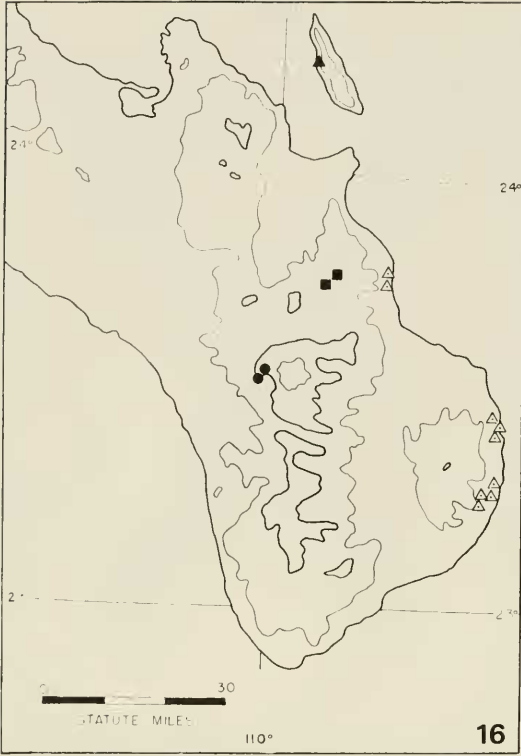


FIGURE 16. Distribution of *Naesiotus altus* (squares), *Naesiotus beldingi* (circles), *Naesiotus harribaueri* (open triangles), and *Naesiotus laevapex* (solid triangle).

"Hills of Lower California near the United States boundary," C. R. Orcutt (Orcutt 1886, as *Macrocyclis sportella*).

This species also occurs in San Diego County, California.

Subgenus *Geomene* Pilsbry, 1927

Haplotrema (Geomene) caelatum (Mazýck, 1886) (Fig. 15)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: San [Santo] Tomás, H. Hemphill, L. G. Yates (Cooper 1892a). Punta Banda and banks of San [Santo] Tomás River, H. Hemphill (Binney 1890, as *Selenites duranti* var. *catalinensis*; CAS). San-to Tomás Canyon, 4.1 mi [6.6 km] from Transpeninsular Highway, along road to harbor, under rocks on wooded slope, W. B. Miller, 27 Jan. 1962 (WBM). San Antonio Canyon, about 5 mi [8 km] N of Johnson Ranch, under stones in rockslide on moist east-facing cliff, L. G. Ingles, 18 Dec. 1927 (Berry 1928; SBMNH).

Haplotrema caelatum also occurs in southern California, from Santa Barbara County to San Diego County.

Superfamily BULIMULOIDEA Family BULIMULIDAE Genus *Naesiotus* Albers, 1850

Naesiotus(?) altus (Dall, 1893)

(Fig. 16)

SYNONYM.—*Bulimulus (Leptobyrus) subspirifer* Mabille, 1895

DISTRIBUTION.—BAJA CALIFORNIA SUR: Sierra Laguna, elev. 3,000 ft [910 m], G. Eisen (USNM; TL, fide Christensen 1978). 1.4 mi [2.3 km] from main highway along access road to microwave station at San Bartolo, among granite boulders in deep ravine above town, elev. ca. 1,400 ft [430 m], W. B. Miller, 19 Dec. 1973 (CCC, WBM); C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). Ca. 0.6 mi [1.0 km] SE of San Bartolo, among large granite boulders along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). 1.3 mi [2.1 km] SE of San Bartolo in San Bartolo Arroyo, A. G. Smith, 20 Jan. 1959 (CAS). Ca. 1.8 mi [2.9 km] SE of San Bartolo, among granite boulders along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM).

This species was formerly assigned to *Rabdotus*, sensu stricto. Hoffman (1988) referred it "probably" to *Naesiotus*, although he had examined neither shells nor anatomy.

Naesiotus beldingi (Cooper, 1892)

(Fig. 16)

SYNONYM.—*Bulimulus (Leptobyrus) dismenicus* Mabille, 1895

DISTRIBUTION.—BAJA CALIFORNIA SUR: Near San José del Cabo; Punta Arena; Sierra Laguna (Cooper 1892b). "Sierra de la Puna, vers 1.800 mètres d'altitude," L. Diguët (Mabille 1895; TL of *Bulimulus (Leptobyrus) dismenicus*). Sierra Laguna, elev. 3,000 ft [910 m], G. Eisen (USNM). "Laguna Valley," elev. 5,000 ft [1,520 m], H. E. Gates, 21 Mar. 1931 (SBMNH). El Sauz, Sierra Laguna, elev. 5,000 ft [1,520 m], E. W. Nelson, E. A. Goldman, 23 Jan. 1906 (USNM). La Laguna, Sierra Laguna, E. W. Nelson, E. A. Goldman, 27 Jan. 1906 (USNM). La Laguna, Sierra Laguna, among rocks on steep slope along creek near cabin, elev. ca. 6,500 ft [1,980 m], C. C. Christensen, W. B. Miller, 31 Dec. 1973 (CCC, WBM). Crest of trail from La Burrera to La Laguna, elev. ca. 6,800 ft [2,070 m], C. C. Christensen, W. B. Miller, 1 Jan. 1974 (CCC, WBM). La Laguna, along trail from cabin to crest of trail at beginning of descent to La Burrera, elev. ca. 6,500–6,800 ft [1,980–2,070 m], C. C. Christensen, 1 Jan. 1974 (CCC). Sierra San Lázaro, elev. 2,000 ft [610 m], G. Eisen (USNM). "San José del Cabo, Cape St. Lucas," L. Belding (USNM).

Published records of the occurrence of this species at San José del Cabo (Cooper 1892b; USNM), Punta Arena (Cooper 1892b), and El Taste Mountains (Cooper 1894) have not been confirmed by recent collections and may, at least in part, have been based upon misidentified material or, in the case of the first of these localities,



FIGURE 17. Distribution of *Naesiotus cosmicus* (squares), *Naesiotus excelsus* (circles), and *Naesiotus montezuma* (triangles).

may represent a very generalized use of the place name.

Naesiotus cosmicus (Mabille, 1895)

(Fig. 17)

DISTRIBUTION.—BAJA CALIFORNIA SUR: “Les Sierras du Sud de la presqu’île” (TL), L. Diguet (Mabille 1895). Canyon in mountains E of old Punta Arena de la Ventana—San Antonio road, 2.0 mi [3.2 km] N of its junction with road leading 3.5 mi [5.6 km] W to Los Planes, C. Church, 30 Dec. 1970 (WBM). Same, but 0.8 mi [1.3 km] N of junction, elev. 500 ft [150 m], C. C. Christensen, 19 Dec. 1975 (CCC). 3 mi [4.8 km] SE of San Antonio, M. D. Robinson, 12 July 1970 (UA). 1.4 mi [2.3 km] from main highway along access road to microwave station at San Bartolo, among granite boulders in deep ravine above town, elev. ca. 1,400 ft [430 m], W. B. Miller, 19 Dec. 1973 (CCC, WBM); C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). Ca. 0.6 mi [1.0 km] SE of San Bartolo, among large granite boulders along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Ca. 1.8 mi [2.9 km] SE of San Bartolo, among granite boulders along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). 5.7 mi [9.2 km] SE of San Bartolo, elev. ca. 1,100 ft [340 m], C. C. Christensen, 25 Dec. 1975 (CCC). Ca. 0.5 mi [0.8 km] beyond El Coro (near Rancho Buena Vista) along trail leading up canyon into mountains,

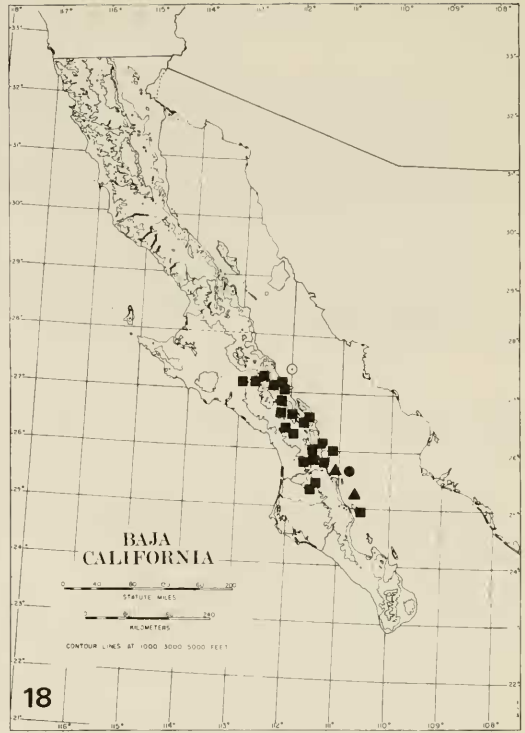


FIGURE 18. Distribution of *Naesiotus dentifer dentifer* (open circle), *Naesiotus dentifer johnstoni* (solid circle), *Naesiotus dentifer lamellifer* (squares), and *Naesiotus dentifer slevini* (triangles).

elev. ca. 2,000 ft [610 m], W. B. Miller, W. B. Miller III, 18 Dec. 1973 (CCC).

Naesiotus dentifer dentifer (Mabille, 1895)

(Fig. 18)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Tortuga (TL), L. Diguet (Mabille 1895); CAS 1921 Exped. (Hanna 1923; CAS, ANSP); H. N. Lowe, 1932 (Lowe 1933; ANSP, SDMNH); J. P. Figg-Hoblyn, 24 Mar. 1952 (SBMNH); 1962 Belvedere Exped. (Emerson and Jacobson 1964); R. V. Moran (WBM).

We regard *Naesiotus dentifer* as a polytypic species with the following included subspecies: *N. d. dentifer* (Isla Tortuga), *N. d. johnstoni* (Isla Santa Catalina), *N. d. lamellifer* (northern peninsular Baja California Sur and Islas San Marcos, Carmen, Danzante, Coronados, and San José), and *N. d. slevini* (Islas Santa Cruz and Monserrate). In our opinion, these allopatric taxa do not differ from each other in shell or anatomical characters to a degree sufficient to justify species-level separation.

Naesiotus dentifer johnstoni (Hanna, 1923)

(Fig. 18)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Santa Catalina (TL). CAS 1921 Exped. (Hanna 1923; CAS, SBMNH); H. N. Lowe, 1932 (Lowe 1933, as *Bulimulus johnsoni* [sic]; ANSP); J. P. Figg-Hoblyn, 14 Apr. 1952 (SBMNH); 1953 ORCA Exped. (Arnaud 1970); 1962 Belvedere Exped. (Emerson and Jacobson 1964); M. D. Robinson, June 1970 (CCC, WBM); L. T. Findley, 13–16 Apr. 1972 (WBM).

Specimens recorded as having been collected on Isla San Benito (ANSP) and Isla Monserrate (I. L. Wiggins, 24 June 1964; CAS) are almost certainly mislabeled.

Naesiotus dentifer lamellifer (Pilsbry, 1896)

(Fig. 18)

SYNONYMS.—*Bulimulus spirifer* var. *orthelasmus* Pilsbry, 1898. *Bulimulus ximenez* Hanna, 1923. *Bulimulus bakeri* Hanna, 1923. *Bulimulus sanmarcosensis* Pilsbry and Lowe, 1932. *Bulimulus carmen* Pilsbry and Lowe, 1932.

DISTRIBUTION.—BAJA CALIFORNIA SUR: "Les montagnes de la Basse Californie vers 800 mètres d'altitude, surtout du volcan de las Virgenes," (Mabille 1895, as *Bulimulus spirifer*). Back of Bahía Agua Verde (Hanna 1923). Mulegé estuary, S entrance at elev. 165–330 ft [50–100 m] 13 mi [21 km] W of San Ignacio, A. G. Smith, 1961 (CAS). Along main road to El Arco ca. 7.5 mi [12.1 km] W of San Ignacio, elev. ca. 600 ft [180 m], W. B. Miller, W. N. Miller, 18 Dec. 1970 (WBM). Along San Ignacio–Santa Rosalía road 23.0 mi [37.0 km] W of Rancho Las Virgenes and 4.0 mi [6.4 km] E of San Ignacio, C. Church, 16 Jan. 1971 (WBM). Along Transpeninsular Highway ca. 5 mi [8 km] E of San Ignacio, C. C. Christensen, W. B. Miller, 4 Dec. 1974 (CCC, WBM). Along Transpeninsular Highway 39.9 mi [64.2 km] NE of Santa Rosalía, C. C. Christensen, J. A. Christensen, 19 Dec. 1973 (CCC). Along road to Santa Agueda ca. 17.6 mi [28.3 km] from Santa Rosalía–Mulegé road, C. Church, 17 Nov. 1970 (WBM). Along Transpeninsular Highway 20 mi [32 km] N of Mulegé, C. C. Christensen, J. A. Christensen, 20 Dec. 1973 (CCC). Along road to San José de Magdalena ca. 6.0 mi [9.7 km] from Santa Rosalía–Mulegé road, C. Church, 22 Nov. 1970 (WBM). Along road to San José de Magdalena ca. 16.7 mi [26.9 km] from Santa Rosalía–Mulegé road, C. Church, 23 Nov. 1970 (WBM). Along road to San José de Magdalena ca. 20.8 mi [33.5 km] from Santa Rosalía–Mulegé road, C. Church, 24 Nov. 1970 (WBM); W. B. Miller, 4 Jan. 1974 (WBM). Along road to San José de Magdalena ca. 26.9 mi [43.3 km] from Santa Rosalía–Mulegé road, C. Church, 24 Nov. 1970 (WBM). Puerto Escondido, under stones and on hillside, T. Craig, 9 Mar. 1928 (SBMNH). Ca. 6 mi [9.7 km] inland of Mulegé, elev. ca. 250 ft [80 m], C. C. Christensen, 22 Oct. 1972 (CCC). Along road to El Potrero 15.0 mi [24.1 km] W of Mulegé bridge, C. Church, 2 Dec. 1970 (WBM). El Potrero Ranch, SW of Mulegé, H. E. Gates, 31 Mar. 1931 (SBMNH). E slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta (2.9 mi [4.7 km] S of El Potrero) to Guajademi, elev. 2,100 ft [640 m], W. B. Miller, D. B. Richman, 22 Oct. 1972 (WBM). Pacific slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta to Guajademi, elev. 2,300 ft [700 m], W. B. Miller,

23 Oct. 1972 (WBM). Sierra de la Giganta above Bahía San Carlos, J. P. Figg-Hoblyn, 11 Apr. 1952 (SBMNH). Bahía de la Concepción, along highway 23 mi [37 km] S of Mulegé, W. B. Miller, W. N. Miller, 19 Dec. 1970 (WBM). Hill above Bahía de la Concepción, L. B. Mousley, 6 Jan. 1955 (SBMNH). Bahía de la Concepción, 3 mi [4.8 km] S of El Coyote, C. Church, 3 Dec. 1970 (WBM). Coyote Bay, Bahía de la Concepción (Hanna 1923). El Requesón, Bahía de la Concepción, ca. 27 mi [43 km] S of Mulegé, W. B. Miller, W. N. Miller, 19 Dec. 1970 (WBM); W. B. Miller, 24 Oct. 1972. Bahía de la Concepción, 16 and 20 mi [26 and 32 km] S of Mulegé, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 12 Nov. 1946 (SBMNH). Puerto Santispaquis, Bahía de la Concepción (TL, desig. by Emerson and Jacobson 1964; ANSP). Punta San Antonio, S end of Bahía San Nicolás, CAS 1921 Exped. (Hanna 1923; TL of *Bulimulus bakeri*; CAS, SBMNH). Bahía San Nicolás, just N of ranch at San Nicolás, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC, WBM). Along El Rosarito–San Nicolás road 1.0 mi [1.6 km] inland of San Nicolás, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC, WBM). Same, 5.3 mi [8.5 km] inland of San Nicolás, elev. ca. 100 ft [30 m], C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC, WBM). Same, 6.5 mi [10.5 km] from Mulegé–Loreto road, C. Church, 5 Dec. 1970 (WBM). Along Canipolé–San José Comondú road 10 mi [16 km] from Canipolé, elev. ca. 1,000 ft [300 m], W. B. Miller, W. N. Miller, 20 Dec. 1970. Along Canipolé–La Purísima road 9.5 mi [15.3 km] E of La Purísima, C. Church, 8 Jan. 1971 (WBM). 6.5 mi [10.5 km] N of San Isidro, C. Church, Nov. 1969 (UA, WBM). Arroyo Mezquitil, SE of Punta Pequeña, J. T. Smith, 1985 (SBMNH). Arroyo de la Purísima, along Canipolé–San Isidro road 3.0 mi [4.8 km] N of San Isidro, elev. 600 ft [180 m], W. B. Miller, W. N. Miller, 21 Dec. 1970 (WBM). Upper Arroyo de la Purísima, 13 mi [21 km] SW of Canipolé, I. L. Wiggins, H. M. Hill, T. Work, 17 Nov. 1946 (SBMNH). 6.8 mi [10.9 km] N of San José Comondú, C. Church, Nov. 1969 (UA, WBM). San José Comondú, R. J. Drake, July 1953 (SBMNH). San José Comondú, elev. 1,200 ft [370 m], W. B. Miller, W. N. Miller, 20 Dec. 1970 (WBM). Comondú Viejo, H. E. Gates, 9 Apr. 1930 (SBMNH). Along Transpeninsular Highway 2.7 mi [4.3 km] N of road to Loreto, C. C. Christensen, S. Kessler, 30 July 1974 (CCC). Along Loreto–San Javier road 8.3 mi [13.4 km] from Transpeninsular Highway, elev. 750 ft [230 m], C. C. Christensen, W. B. Miller, 25 Oct. 1972 (CCC, WBM). Along Loreto–San Javier road 0.6 mi [1.0 km] E of San Javier, C. Church, 11 Dec. 1970 (WBM). San Javier, elev. 1,200–1,500 ft [370–460 m], W. B. Miller, 24 Oct. 1971 (WBM); C. C. Christensen, P. N. D'Eliscu, W. B. Miller, R. L. Reeder, D. B. Richman, 25 Oct. 1972 (CCC, WBM). Juncalito, W. B. Miller, 3 Jan. 1974 (CCC); C. C. Christensen, S. Kessler, 30 July 1974 (CCC). 1 mi [1.6 km] S of Chuenque, C. Church, 8 Dec. 1970 (WBM). Puerto Escondido, H. N. Lowe, Dec. 1931 (ANSP, SBMNH). Canyon west of Puerto Escondido (Hanna 1923). Along Transpeninsular Highway at km 69 N of Villa Insurgentes, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC, WBM). Along Transpeninsular Highway 31 mi [50 km] N of Villa Insurgentes, elev. 900 ft [270 m], W. B. Miller, 31 Oct. 1971 (WBM). Isla San Marcos (Pilsbry and Lowe 1932; TL of *Bulimulus sanmarcosensis*; ANSP); J. P. Figg-Hoblyn, 22–23 Apr. 1952 (SBMNH); SW point, G. D. Hanna et al., 31 Mar. 1953, ORCA Exped. (CAS); SW side of island, elev. ca. 300 ft [90 m], R. V. Moran, 22 Mar. 1966 (SBMNH); SW side of island near gypsum mine, M. D. Robinson, 9 Sep. 1970 (CCC, WBM). Islas Coronados, CAS 1921 Exped. (Hanna 1923,

as *B. ximenez*; CAS); C. C. Christensen, 1 Aug. 1974 (CCC); S end of [large] island, R. V. Moran, 3 Apr. 1962 (SDMNH). Isla Carmen, H. N. Lowe (ANSP, SDMNH); 1953 ORCA Exped. (CAS); several locations (Hanna 1923); Bahía Marquer (Hanna 1923; TL of *Bulimulus ximenez*; Jacobson 1958); Puerto Balandra, J. P. Figg-Hoblyn, 18 Apr. 1952 (SBMNH); C. C. Christensen, 1 Aug. 1974 (CCC); Bahía Salinas (Pilsbry and Lowe 1932; TL of *Bulimulus carmen*; ANSP, SBMNH); S end of island (Pilsbry and Lowe 1932). Isla Danzante, H. N. Lowe (SDMNH); R. V. Moran, 7 Apr. 1962 (SDMNH); I. L. Wiggins, 21–22 June 1964 (CAS); S anchorage, F. Baker, CAS 1921 Exped. (Hanna 1923; CAS, SDMNH). Isla San José, G. D. Hanna et al., 1953, ORCA Exped. (CAS).

Naesiotus dentifer slevini (Hanna, 1923)

(Fig. 18)

SYNONYM.—*Bulimulus santacruzensis* Hanna, 1923

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Monserrate (TL), J. R. Slevin, E. P. Van Duzee, J. C. Chamberlin, V. Owen, I. M. Johnston, CAS 1921 Exped. (Hanna 1923; CAS, SDMNH); H. N. Lowe, 1931 (Pilsbry and Lowe 1932, Lowe 1933; ANSP, SDMNH); W. K. Emerson, C. F. Harbison, R. V. Moran, 1962, Belvedere Exped. (Emerson and Jacobson 1964; SDMNH); R. C. Banks, 11 May 1963 (SDMNH). Isla Santa Cruz, F. Baker, J. C. Chamberlin, I. M. Johnston, V. Owen, J. R. Slevin, E. P. Van Duzee, CAS 1921 Exped. (Hanna 1923; TL of *Bulimulus santacruzensis*; CAS, SDMNH); H. N. Lowe, 1932 (Lowe 1933; ANSP, SDMNH); J. P. Figg-Hoblyn, 13 Apr. 1952 (SBMNH); G. D. Hanna et al., 26 Mar. 1953, ORCA Exped. (Arnaud 1970; CAS); Puritan-AMNH 1957 Exped. (Jacobson 1958); W. K. Emerson, R. V. Moran, I. L. Wiggins, 1962, Belvedere Exped. (Emerson and Jacobson 1964; SDMNH).

Naesiotus excelsus (Gould, 1853)

(Fig. 17)

SYNONYMS.—*Bulimulus elatus* Gould, 1853. *Bulimulus* (*Scutalus*) *cacotyus* Mabilie, 1895. *Bulimulus excelsus* var. *sinaloae* Pilsbry, 1897.

DISTRIBUTION.—BAJA CALIFORNIA SUR: California (TL) (Gould 1853). “Les Sierras du Sud de la presqu’île” (Mabilie 1895; TL of *Bulimulus* (*Scutalus*) *cacotyus*). La Paz (Binney 1861); L. Belding (USNM); H. N. Lowe (ANSP, SDMNH); Henderson Collection (USNM). N slope of La Calavera Mt. above Playa Coromuel, W. B. Miller, 18 Apr. 1958 (WBM). Playa Coromuel, R. S. Houston, J. D. Kudenov, W. B. Miller, 28 Dec. 1971 (WBM); C. C. Christensen, 26 Oct. 1972 (CCC). 12.9 mi [20.6 km] E of La Paz on road to Las Cruces, A. G. Smith (CAS). Cliff of decomposing granite near Rancho Viniamos, 9 mi [12.6 km] E of La Paz, H. E. Gates, 4 Mar. 1930 (SBMNH).

Gould’s report of this species from “California” reflects a broader definition for that place name than is now in use. The locality “Sinaloa, state of Sinaloa” reported by Pilsbry (1897–1898) for his “*B. e.* var. *sinaloae*” is undoubtedly erroneous. A USNM lot collected by Belding is

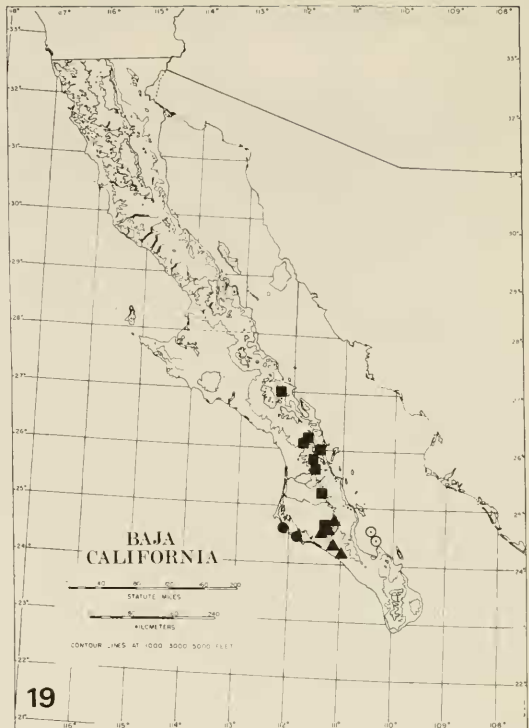


FIGURE 19. Distribution of *Naesiotus gabbi* (triangles), *Naesiotus gigantensis* (squares), *Naesiotus hannai* (solid circles), *Naesiotus vesityianus* (open circles).

labeled “Espíritu Santo, off Lower California,” but the species has not been found on that island by recent workers and we doubt its occurrence there.

Naesiotus gabbi (Crosse and Fischer, 1872)

(Fig. 19)

DISTRIBUTION.—BAJA CALIFORNIA SUR: California Mexicana (TL) (Crosse and Fischer 1872; ANSP). Rock outcrop E of road to La Presa, 2.6 mi [4.2 km] NE of junction with road between San Luis Gonzaga and El Obispo, elev. 600 ft [180 m], C. C. Christensen, J. A. Christensen, 16 Dec. 1975 (CCC). Along road between El Obispo and Rancho Tinajitas, I. L. Wiggins, 20 Nov. 1959 (CAS). NE side of Transpeninsular Highway at km 135 N of La Paz, among boulders on south slope of small arroyo near microwave station “El Rifle,” elev. ca. 400 ft [120 m], C. C. Christensen, J. A. Christensen, 26 Dec. 1975 (CCC). Rock outcrop NE of Transpeninsular Highway ca. 0.4 mi [0.6 km] NW of km 105 N of La Paz, elev. 400 ft [120 m], C. C. Christensen, W. B. Miller, 6 Dec. 1974 (CCC, WBM). Below caprock on SE slope of large arroyo, 0.6 mi [1.0 km] NE of Transpeninsular Highway at km 77 N of La Paz, R. S. Houston, J. D. Kudenov, W. B. Miller, 23–26 Oct. 1971 (WBM); C. C. Christensen, W. B. Miller, 3 Aug. 1974 and 6 Dec. 1974 (CCC, WBM).

***Naesiotus gigantensis* (Christensen and Miller, 1977)**

(Fig. 19)

DISTRIBUTION.—BAJA CALIFORNIA SUR: San Javier, in large rockslide immediately S of the mission, elev. 350–450 m (TL), W. B. Miller, 24 Oct. 1971 (Christensen and Miller 1977; WBM); C. C. Christensen, P. N. D'Eliscu, W. B. Miller, R. L. Reeder, D. B. Richman, 25 Oct. 1972 (Christensen and Miller 1977; ANSP, CAS, CCC, DMNH, R. L. Reeder, WBM). Inland of San José de Magdalena on the road to Guadalupe, ca. 26.9 mi [43.3 km] W of Santa Rosalía–Mulegé road, C. Church, 24 Nov. 1970 (Christensen and Miller 1977; WBM). 6.8 mi [10.9 km] N of San José Comondú, C. Church, Nov. 1969 (Christensen and Miller 1977; UA). San José Comondú, R. J. Drake, July 1953 (Christensen and Miller 1977; CAS, UA); V. Roth, 15 Feb. 1966 (Christensen and Miller 1977; UA). Along road from Loreto to San Javier 8.3 mi [13.4 km] W of Transpeninsular Highway, elev. 750 ft [230 m], W. B. Miller, 25 Oct. 1972 (WBM), 25 Oct 1972 (WBM). 0.6 mi [0.8 km] E of San Javier, C. Church, 11 Dec. 1970 (Christensen and Miller 1977; WBM). 9.8 mi [15.8 km] W of San Javier along road to Santo Domingo, C. Church, 12 Dec. 1970 (Christensen and Miller 1977; WBM). Along Transpeninsular Highway 45 mi [72 km] S of Loreto and 31 mi [50 km] NE of Villa Insurgentes, elev. 900 ft [270 m], W. B. Miller, 23 Oct. 1971 (Christensen and Miller 1977; WBM). Along road between El Obispo and Rancho Tinajitas, I. L. Wiggins, 20 Nov. 1970 (Christensen and Miller 1977; CAS).

***Naesiotus hannai* (Pilsbry, 1927)**

(Fig. 19)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Magdalena: 4 mi [6.4 km] S of village, CAS 1922 Exped. (Pilsbry 1927; CAS); in rocks in ravine below Mt. Isabel, C. C. Christensen, W. B. Miller, 17 May 1975 (CCC, WBM). Isla Margarita, USFCS ALBATROSS (USNM); E. W. Nelson, E. A. Goldman, 30 Nov. 1905 (USNM); P. Bartsch, 19 Mar. 1911 (USNM); H. N. Lowe (ANSP, SDMNH); under stones within one mile, west and south, of the village near the center of the east side of the island (TL), G D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH); in rocky outcrops in hills just W of road from Puerto Alcatraz to Puerto Cortez, C. C. Christensen, W. B. Miller, 20 May 1975 (CCC, WBM); ca. 2 mi [3.2 km] NE of Margarita Peak, J. E. Fitch, 28 Nov. 1952 (SBMNH).

***Naesiotus harribaueri* (Jacobson, 1958)**

(Fig. 16)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Fraile Bay [Bahía de los Frailes], dead on sand dunes and decomposed granite (TL), W. K. Emerson, 19 Apr. 1957 (Jacobson 1958; AMNH). Los Frailes (Arnaud 1970, as *Bulimulus montezuma*). Along road to El Cardonal 0.5 mi [0.8 km] S of Punta Pescadores, elev. ca. 30 ft [10 m], W. B. Miller, 17 Dec. 1973 (WBM). Along road to El Cardonal, near Punta Pescadores, 5.8 mi [9.3 km] N of junction with San Bartolo–Santiago road, W. B. Miller, 20 Dec. 1973 (WBM). Low hills at elevation ca. 100 ft [30 m] behind Cabo Pulmo, D. R. Shasky, Apr. 1965 (SBMNH). Along La Ribera–Los Frailes road 0.8 mi [1.3 km] N of El Pulmo, C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC). Bahía Pulmo, R. C. Brusca, 6 Mar. 1974 (CCC).

0.3 mi [0.5 km] E of Santa Catarina–Los Frailes road 5.3 mi [8.5 km] S of Los Frailes, elev. ca. 50 ft [15 m], C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC). Nine localities along Santa Catarina–Los Frailes road, from 20.2 mi [32.3 km] to 28.4 mi [45.7 km] NE of Santa Catarina, elev. 150–750 ft [45–230 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC, WBM). Los Frailes, in midden, J. E. Fitch, 3 Dec. 1952 (SBMNH).

***Naesiotus laevapex* (Christensen and Miller, 1977)**

(Fig. 16)

DISTRIBUTION.—BAJA CALIFORNIA SUR: W side of Isla Cerralvo, 0.5 km inland of beach at El Limoña anchorage, elev. 50–100 m (TL), C. C. Christensen, 8 Aug. 1974 (Christensen and Miller 1977; CAS, CCC, DMNH, WBM).

***Naesiotus montezuma* (Dall, 1893)**

(Fig. 17)

SYNONYM.—*Bulimulus (Scutalus) acholus* Mabille, 1895.

DISTRIBUTION.—BAJA CALIFORNIA SUR: “Montagnes de la Basse Californie” (Mabille 1895; TL of *Bulimulus (Scutalus) acholus*). “Lower California, mostly from the mountainous region (3,500 ft alt.)” (TL) (Dall 1893b). Cabo San Lucas, J. Xántus (Binney 1861, as *Bulimulus proteus*; USNM). Sierra Laguna, elev. 3,500 ft, G. Eisen (Cooper 1892b, as *B. proteus*; USNM). Sierra El Taste, G. Eisen (Cooper 1894; USNM). “Toutes les Sierras du Sud de la presqu’île, et, en particulier, auprès du Rancho de San Bartolo” (Mabille 1895). 3 mi [4.8 km] SE of San Antonio, M. D. Robinson, 12 July 1970 (CCC). Foot of Sierra Laguna, elev. 1,000 ft [300 m], 23°40'N, 110°10'W, H. E. Gates, 21 Mar. 1931 (SBMNH). Trail on W face of Sierra Laguna, elev. 1,200–2,500 ft [370–760 m], G. E. Lindsay, 25 July 1951 (SBMNH). W slope of Sierra Laguna, elev. 3,000 ft [910 m], H. E. Gates, 21 Mar. 1931 (SBMNH). La Laguna, along trail from cabin to crest of trail at beginning of descent to La Burrera, elev. 6,500–6,800 ft [1,980–2,070 m], C. C. Christensen, W. B. Miller, 1 Jan. 1974 (CCC, WBM). Along trail from La Burrera to La Laguna, elev. 3,000–6,800 ft [900–2,070 m], C. C. Christensen, W. B. Miller, 1–2 Jan. 1974 (CCC, WBM). Along trail in arroyo W of Boca de la Sierra, elev. 1,000–1,600 ft [300–490 m], W. B. Miller, 7 Dec. 1974 (CCC, WBM). 10 mi [16 km] W of Miraflores, foothills, elev. 1,500 ft [460 m], E. W. Nelson, E. A. Goldman, 20 Jan. 1906 (USNM). Arroyo Candelaria 4.2 mi [6.8 km] E of Migriño and 2.1 mi [3.4 km] W of Candelaria, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1970 (CCC). Along Todos Santos–Cabo San Lucas road 6.2 mi [10.0 km] S of Migriño, C. Church, 23 Dec. 1970 (WBM). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, elev. ca. 1,500 ft [460 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM); C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (CCC); C. C. Christensen, 9 Aug. 1974 (CCC). Along Todos Santos–Cabo San Lucas road 2.1 mi [3.4 km] N of El Saucito, elev. ca. 1,500 ft [460 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (CCC, WBM); C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Granite outcrops, gravelly hills

9 mi [12.6 km] NE of Cabo San Lucas, H. E. Gates, 22 Mar. 1930 (SBMNH).

Naesiotus pallidior (Sowerby, 1833)

(Fig. 20)

SYNONYMS.—*Bulimulus vegetus* Gould, 1853. *Bulimulus (Scutalus) pallidior* var. *striatulus* Dall, 1893. *Bulimulus (pallidior?) vegetus* variety *vegexspiza* Cooper, 1894.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Along road 31.5 mi [50.7 km] N of La Paz, M. D. Robinson, 24 Jan. 1972 (UA). Todos Santos, M. E. Jones, 1928 (SBMNH). 1.3 mi [2.1 km] S of Todos Santos, elev. ca. 100 ft [30 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM). Pedricitos Ranch, 23°40'N, 110°10'W, H. E. Gates, 27 Mar. 1931 (SBMNH). Trail on W face of Sierra Laguna, elev. 1,200–2,500 ft [370–760 m], G. E. Lindsay, 25 July 1951 (SBMNH). Along road to La Burrera, 0.6 mi [1.0 km] SW of La Burrera, W. B. Miller, 30 Dec. 1973 (WBM). Along road to La Burrera, 0.8 mi [1.3 km] SW of La Burrera, elev. 1,900 ft [580 m], C. C. Christensen, W. B. Miller, 30 Dec. 1973 (WBM). Along road to La Burrera, ca. 1.5 mi [2.4 km] SW of La Burrera and 12.3 mi [19.8 km] E of Todos Santos–Cabo San Lucas road, elev. 1,600 ft [490 m], C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along road to La Burrera, 2.0 mi [3.2 km] SW of La Burrera and 12.0 mi [19.3 km] E of Todos Santos–Cabo San Lucas road, C. Church, 22 Dec. 1970 (WBM); C. C. Christensen, J. A. Christensen, W. B. Miller, 30 Dec. 1973 (CCC, WBM). Along road to La Burrera, 7.0 mi [11.3 km] E of Todos Santos–Cabo San Lucas road, elev. 1,000 ft [300 m], C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along road to La Burrera, 5.3 mi [8.5 km] E of Todos Santos–Cabo San Lucas road and 1.0 mi [1.6 km] E of junction with road to Los Horconitos, W. B. Miller, 30 Dec. 1973 (WBM). Along road to La Burrera, 3.0 mi [4.8 km] E of Todos Santos–Cabo San Lucas road, C. Church, 21 Dec. 1970 (WBM); W. B. Miller, 29 Dec. 1973. Ca. 5 mi [8 km] S of Todos Santos, C. C. Christensen, J. A. Christensen, 19 Dec. 1975 (CCC). San Venancio Ranch, E of Pescadero, E. S. Ross, 8 Oct. 1941 (CAS). Rancho Cañada Honda, between Todos Santos and coast road, J. T. Smith, 15 Mar. 1984 (SBMNH). Todos Santos, G. E. Lindsay, 27 July 1951 (SBMNH). Along Todos Santos–Cabo San Lucas road 3.1 mi [5.0 km] S of Las Piedritas and ca. 19.8 mi [31.9 km] S of Todos Santos, C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of Las Barrancas, elev. 500 ft [150 m], C. C. Christensen, 21 Dec. 1975 (CCC). Arroyo Candelaria 2.3 mi [3.7 km] NE of Migrño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, elev. 1,500 ft [460 m], C. C. Christensen, 9 Aug. 1974 (CCC). 20 mi [32 km] S of Todos Santos, M. E. Jones, 18 Sep. 1930 (SBMNH). In wash below mountains immediately behind Cabo San Lucas, ca. 0.25 mi [0.4 km] W of N end of town of San Lucas, C. C. Christensen, J. A. Christensen, W. B. Miller, 24 Dec. 1973 (CCC, WBM). Cape St. Lucas, J. Xántus (USNM). 4.7 mi [7.5 km] SE of San Bartolo, C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along San Bartolo–Santiago road 0.8 mi [1.3 km] S of Rancho Buena Vista monument, C. C. Christensen, J. A. Christensen, W. B. Miller, 27 Dec. 1973 (CCC, WBM). Along San Bartolo–Santiago road at junction with road to El Coro (near Rancho Buena Vista), W. B. Miller, 18 Dec. 1973 (WBM). Santiago, L. B. Mousley, 13 Jan. 1955



FIGURE 20. Distribution of *Naesiotus pallidior* (triangles) and *Rabdotus ceralboensis* (square).

(SBMNH). Along coast road from Agua Caliente to Los Frailes 5.2 mi [8.4 km] NW of La Ribera, C. Church, 29 Dec. 1970 (WBM). Along La Ribera–Los Frailes road 5.0 mi [8.0 km] NW of Casa Huéspedes Laguna and ca. 5 mi [8 km] SE of La Ribera, elev. 300 ft [60 m], C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC). Along La Ribera–Los Frailes road 3.1 mi [5.0 km] NW of Casa Huéspedes Laguna and ca. 6.7 mi [10.8 km] SE of La Ribera, C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC). Hills near Punta Arena, H. E. Gates, 5 Mar. 1931 (SBMNH, WBM). Along San Bartolo–Santiago road 9.8 mi [15.8 km] S of Rancho Buena Vista, C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). 6.8 mi [11.0 km] S of Misión Santiago, or 1 mi [1.6 km] S of Refugio, G. D. Hanna, J. W. Durham, 24 Apr. 1965 (CAS). 1.5 mi [2.4 km] SE of Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). Miraflores, H. E. Gates, 15 Mar. 1930 (SBMNH). Along Santiago–San José del Cabo road 4.5 mi [7.2 km] S of Caduano, C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). Along Santa Catarina–Los Frailes road 15.6 mi [25.1 km], 15.9 mi [25.6 km], 17.9 mi [28.8 km], and 19.4 mi [31.2 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC, WBM). Along Santa Catarina–Los Frailes road 13.5 mi [21.7 km] NE of Santa Catarina, elev. 1,200 ft [370 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC). San José Viejo, C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). 1.1 mi [1.8 km] S of Rancho Los Dedos (ca. 6.5 mi [10.5 km] SE of Santa Catarina), C. C. Christensen, J. A. Christensen, W. B. Miller, 23 Dec.



FIGURE 21. Distribution of *Naesiotus rimatus* (squares) and *Naesiotus spirifer* (circles).

1973 (CCC, WBM). Near coast 11.5 mi [18.5 km] NE of Rancho La Laguna and 4.3 mi NE of Campamento La Fortuna, C. C. Christensen, J. A. Christensen, W. B. Miller, 23 Dec. 1973 (CCC, WBM). Rancho La Laguna, H. E. Gates, 3 Mar. 1931 (SBMNH); C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC). East of Arroyo San José, NE of Santa Anita, J. T. Smith, 1985 (SBMNH). Canyon 10 mi [16 km] N of San José del Cabo, H. E. Gates, 18 Mar. 1930 (SBMNH). 1.1 mi [1.8 km] NE of lighthouse NE of San José del Cabo and ca. 4.5 mi [7.2 km] SW of Rancho La Laguna, C. C. Christensen, J. A. Christensen, 23 Dec. 1973 (CCC, WBM). San José, L. Belding (USNM); M. E. Jones, Jan. 1928 (SBMNH); H. N. Lowe, 20 Mar. 1929 (SBMNH). Seaward of Transpeninsular Highway at km 24 (14.9 mi NE of Cabo San Lucas), C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). Granite outcrops, gravelly hills 9 mi [12.6 km] NE of Cabo San Lucas, H. E. Gates, 22 Mar. 1930 (SBMNH). Cabo San Lucas, J. P. Figg-Hoblyn, 19 May 1952 (SBMNH).

Records of this species from Isla Carmen (Dall 1893b, Stearns 1894; USNM) are based upon mislabeled specimens.

Naesiotus rimatus (Pfeiffer, 1846)

(Fig. 21)

SYNONYMS.—*Bulimulus* (*Mesembrinus*) *inascendens* var. *bryanti* Cooper, 1891. *Bulimulus* (*Leptobysus*) *inascendens* var. *monticola* Dall, 1893.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Near San José del Cabo, W. E. Bryant (Cooper 1891; USNM). San José del Cabo to La Paz (Cooper 1892a). Sierra el Taste, G. Eisen (Cooper 1894). Rancho Guamuchil, J. R. Slevin, 7 Aug. 1919 (Hanna 1923; CAS). Elev. 3,000 ft, Sierra Laguna, G. Eisen (USNM). Small canyon in mountains E of old Punta Arena de la Ventana—San Antonio road 0.8 mi [1.3 km] N of its junction with road leading 3.5 mi [5.6 km] W to Los Planes, elev. ca. 500 ft [150 m], C. C. Christensen, 19 Dec. 1975 (CCC; cf. *R. rimatus*). Along trail in arroyo W of Boca de la Sierra, elev. 1,000–1,600 ft [300–490 m], W. B. Miller, 26 Dec. 1970 (WBM). Along trail 1–2 mi [1.6–3.2 km] W of Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). Cañon San Pedro, between Cayuco and San Pedro, ca. 5 mi [8 km] W of Caduano, elev. 300–400 ft [90–120 m], R. V. Moran, 12 May 1959 (CAS). Arroyo Candelaria 4.2 mi [6.8 km] E of Migriño and 2.1 mi [3.4 km] W of Candelaria, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Arroyo Candelaria at Migriño, C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Sierra San Lázaro, G. Eisen (USNM). Gravelly hills 9 mi [12.6 km] NE of Cabo San Lucas, H. E. Gates, 22 Mar. 1930 (SBMNH). Mountains immediately behind Cabo San Lucas, ca. 0.25 mi [0.4 km] W of N end of town of San Lucas, C. C. Christensen, J. A. Christensen, W. B. Miller, 24 Dec. 1974 (CCC, WBM). Along Santa Catarina—Los Frailes road 23.4 mi [37.7 km] NE of Santa Catarina, elev. 500 ft [150 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC, WBM). Along Santa Catarina—Los Frailes road 3.2 mi [5.1 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, W. B. Miller, 23, 26 Dec. 1973 (CCC, WBM). 0.6 mi [1.0 km] SW of Rancho La Laguna and ca. 0.6 mi [1.0 km] NE of San José del Cabo, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975.

No type locality has been designated for *N. rimatus*. Christensen (1978) indicated that the type locality of *Bulimulus* (*Mesembrinus*) *inascendens* var. *bryanti* should be restricted to San José del Cabo and that, pending a lectotype designation, the type locality of *B. (Leptobysus) inascendens* var. *monticola* should be regarded as Sierra Laguna, at 3,000 ft [900 m] elevation.

Naesiotus spirifer (Gabb, 1868)

(Fig. 21)

SYNONYM.—*Bulimulus* (*Leptobysus*) *lapidovagus* Mabille, 1895.

DISTRIBUTION.—BAJA CALIFORNIA SUR: "In the mountains, among rocks from San Antonio, below La Paz, to near San Borja, and in the mountains perhaps even farther north" (TL) (Gabb 1868; Baker 1963; Coan and Bogan 1988; ANSP). "Sierra de la Cacachila au Sud de la Paz" (Mabille 1895; TL of *Bulimulus* (*Leptobysus*) *lapidovagus*). Sierra Cacachila, along La Paz—Los Planes road 9.3 mi [15.0 km] SE of La Paz—Todos Santos road, elev. ca. 1,450 ft [440 m], R. S. Houston, J. D. Kudenov, W. B. Miller, 27 Oct. 1971 (WBM). Sierra Cacachila, along La Paz—Los Planes road 9.8 mi [15.8 km] E of La Paz—Todos Santos road, elev. 1,400 ft [430 m], C. C. Christensen, J. A. Christensen, 18 Dec. 1975 (CCC). Sierra Cacachila, along

La Paz–Los Planes road 2.1 mi [3.4 km] SE of La Huerta and 14.4 mi [23.2 km] SE of La Paz–Todos Santos road, elev. 2,100–2,200 ft [640–670 m], C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). Sierra Cacachila, 4.6 mi [7.4 km] SE of La Huerta and 0.5 mi [0.8 km] SW of La Paz–Los Planes road, W. B. Miller, 8 Dec. 1974 (WBM). Sierra Cacachila, along La Paz–Los Planes road 20.2 mi [32.5 km] SE of La Paz–Todos Santos road, elev. ca. 2,250 ft [690 m], R. S. Houston, J. D. Kudenov, W. B. Miller, 27 Oct. 1971 (WBM). Sierra Cacachila, along La Paz–Los Planes road 15.5 mi [24.9 km] W of Los Planes, C. Church, 30 Dec. 1970 (WBM). Along road to El Carrizal 2 mi [3.2 km] W of La Paz–Todos Santos road and 7 mi [11 km] S of San Pedro, C. Church, Dec. 1969 (UA). Mountains E of La Paz–Todos Santos road, near road from Valle Perdido to Las Gallinas, 0.3 mi [0.5 km] SE on side road from point 1.2 mi [1.9 km] from shrine near Las Gallinas, C. Church, 20 Dec. 1970 (WBM); C. C. Christensen, W. B. Miller, 29 Dec. 1973 (CCC, WBM). Along road from Valle Perdido to ranch at Bajada del Molino 2.0 mi [3.2 km] E of Bajada del Molino, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1973 (CCC, WBM). 1.3 mi [2.1 km] N of El Triunfo, A. G. Smith, 20–21 Jan. 1959 (CAS).

Naesiotus veseyanus (Dall, 1893)

(Fig. 19)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Espíritu Santo (TL), L. Belding (Dall 1893; USNM); H. E. Gates, 17 Mar. 1931 (SBMNH); El Candelero, I. M. Johnston, CAS 1921 Exped. (Hanna 1923; CAS); north end section of island, I. M. Johnston, CAS 1921 Exped. (Hanna 1923; CAS); NW end of island, J. P. Figg-Hoblyn, 5 Apr. 1952 (SBMNH); Ballena Cove, elev. ca. 100 ft [30 m], W. K. Emerson et al., 1962, Belvedere Exped. (Emerson and Jacobson 1964; SDMNH); SW side of island, C. C. Christensen, 5 Aug. 1974 (CCC); N talus slope of peak on S end of island, M. W. Williams, 18 Apr. 1937 (SBMNH). "Espíritu Santo Island, North Island" [=Isla Partida], V. Owen, CAS 1921 Exped. (Hanna 1923; CAS). Isla Partida, west side, W. K. Emerson et al., 1962, Belvedere Exped. (Emerson and Jacobson 1964; SDMNH).

Naesiotus xantusi (Binney, 1861)

(Fig. 22)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Cabo San Lucas (TL), J. Xántus (Binney 1861; USNM). Sierra El Taste (Cooper 1894). Along road from Valle Perdido to ranch at Bajada del Molino 2.0 mi [3.2 km] from Bajada del Molino, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1973 (CCC, WBM). Along trail from La Burrea to La Laguna, elev. ca. 3,000 ft [910 m], W. B. Miller, 2 Jan. 1974 (WBM). Sierra Laguna, Animas Ranch, B. Hammerly, E. S. Ross, 12 Oct. 1941 (CAS). Canyon W of Boca de la Sierra, ca. 4 mi [6.4 km] above town, elev. ca. 1,500 ft [460 m], W. B. Miller, 26 Dec. 1970 (WBM). 1–2 mi [1.6–3.2 km] above Boca de la Sierra, W. B. Miller, 7 Dec. 1974 (WBM). Arroyo Candelaria, 2.1 mi [3.4 km] W of Candelaria, elev. ca. 300 ft [90 m], C. C. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria, 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road, 2.2 mi [3.5 km] N of El Saucito, elev. ca. 1,500 ft [460 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM); C. C. Christensen, W. B. Miller, 22 Dec. 1973; C. C. Christensen, 9 Aug. 1974 (CCC). Along Todos Santos–Cabo

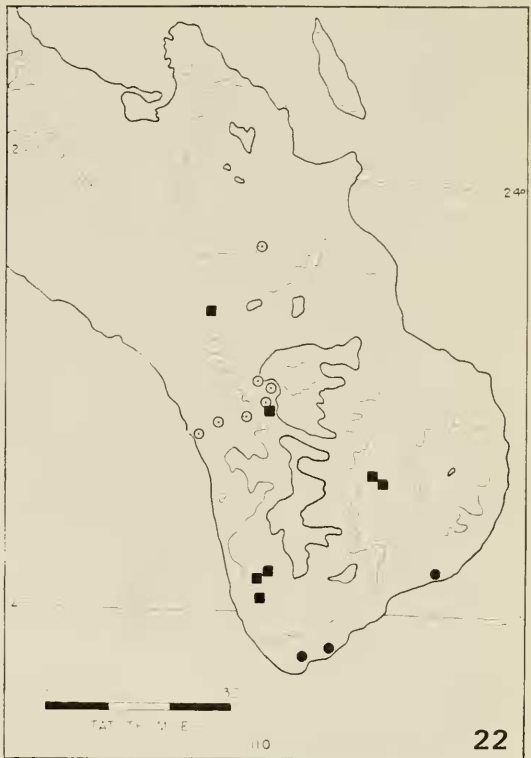


FIGURE 22. Distribution of *Naesiotus xantusi* (squares), *Rabdodus levis* (open circles), and *Rabdodus pilula* (solid circles).

San Lucas road, 2.1 mi [3.4 km] N of El Saucito, elev. ca. 1,500 ft [460 m], C. C. Christensen, W. B. Miller, 22 Dec. 1973 (CCC, WBM).

Naesiotus(?) sp.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Mountains E of La Paz–Todos Santos road, near road from Valle Perdido to Las Gallinas, 0.3 mi [0.5 km] SE on side road from junction 1.2 mi [2.0 km] from shrine near Las Gallinas, W. B. Miller, 29 Dec. 1973 (WBM). Along road from Valle Perdido to ranch at Bajada del Molino 2.0 mi [3.2 km] E of Bajada del Molino, in rockslides in N-facing slope of large arroyo S of road, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1974 (CCC, WBM). 1.4 mi [2.3 km] from main highway along access road to microwave station at San Bartolo, among granite boulders in deep ravine above town, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). Ca. 0.6 mi [1.0 km] SE of San Bartolo, among large granite boulders along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Ca. 1.8 mi [2.9 km] SE of San Bartolo, on S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Along road to La Burrea 7.0 mi [11.2 km] E of Todos Santos–Cabo San Lucas road, elev. 1,000 ft [300 m], C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Arroyo W of Boca de la Sierra, ca. 4 mi [6.4 km] above town, elev. ca. 1,500 ft [460 m], W. B. Miller, 26 Dec. 1970. Along trail in arroyo 1–2 mi [1.6–3.2 km] above Boca de la Sierra, C. C. Christensen, W. B. Miller,



FIGURE 23. Distribution of *Rabdodus chamberlini* (triangle) and *Rabdodus sufflatus* (squares).

7 Dec. 1974 (CCC, WBM). Along Todos Santos-Cabo San Lucas road, 3.1 mi [5.0 km] S of Las Piedritas, C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along Todos Santos-Cabo San Lucas road, 2.2 mi [3.5 km] N of Las Barrancas, elev. 500 ft [150 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Arroyo Candelaria, 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). 0.6 mi [1.0 km] SW of Rancho La Laguna and 4.7 mi [7.5 km] NE of lighthouse E of San José del Cabo, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC).

The above records include the *Rabdodus* new species A and B of Christensen (1978). At least one species, not assignable to any recognized species of *Naesiotus*, occurs at several localities in the Cape region. The anatomy is unknown, and more material will be necessary to clarify its relationships.

Genus *Rabdodus* Albers, 1850
Subgenus *Rabdodus* sensu stricto

Rabdodus (Rabdodus) ceralboensis (Hanna, 1923)
(Fig. 20)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Cerralvo, 1953 ORCA Exped. (CAS); west of Ruffo's ranch house (TL), J. C. Chamberlin, 7 June 1923, CAS 1921 Exped. (Hanna 1923; CAS); El Mostrador, J. C. Chamberlin, CAS 1921 Exped. (Hanna 1923; CAS); El Mostrador, north of Ruffo's ranch, west side of island, elev. 75–150 ft [23–46 m], among boulders (Emerson and Jacobson 1964); Punta Gordas (Arnaud 1970); 1 mi [1.6 km] SE of Piedras Gordas Point, G. D. Hanna, 20–21 Mar. 1953 (CAS); SW end of island, in arroyo halfway between sea and divide, W. Farmer, R. Banks, 22 May 1962 (SDMNH); S end of island, J. P. Figg-Hoblyn, 1–2 Apr. 1952 (SBMNH).

A single shell of *Rabdodus ceralboensis* is contained in a mixed lot with *Naesiotus dentifer slevini* from Isla Santa Cruz (WBM ex CAS), undoubtedly by error. The species is otherwise recorded only from Isla Cerralvo.

Rabdodus (Rabdodus) chamberlini (Hanna, 1923)
(Fig. 23)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla San Diego (TL), J. C. Chamberlin, 27 May 1921, CAS 1921 Exped. (Hanna 1923; CAS); I. L. Wiggins, 19 Apr. 1962 (CAS); elev. 50 ft [15 m] to crest of island, 1962, Belvedere Exped. (Emerson and Jacobson 1964; SDMNH).

Rabdodus (Rabdodus) levis (Dall, 1893)
(Fig. 22)

SYNONYM.—*Bulimulus (Thaumastus) digueti* Mabille, 1895.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Rancho Lagunas, Punta Arena, W. E. Bryant; Sierra Laguna, mostly near La Chuparosa [sic], elev. 2,000 ft (Cooper 1892b, as *Bulimulus xantusi*; Dall 1893b; USNM). El Taste Mountains, elev. about 4,000 ft; near Cape St. Lucas (Cooper 1894). Sierra de la Victoria (Mabille 1895; TL of *Bulimulus (Thaumastus) digueti*). Along San Antonio-San Bartolo road 5.9 mi [9.4 km] from San Antonio. C. C. Christensen, 10 Aug. 1974 (CCC). La Aguja, ca. 16 mi [26 km] NE of Todos Santos, elev. 1,900 m, R. V. Moran, 18 May 1959 (CAS). Trail to meadow at La Laguna, elev. 4,500–6,000 ft [1,370–1,830 m], G. E. Lindsay, 25 July 1951 (SBMNH). La Laguna, Sierra Laguna, E. W. Nelson, E. A. Goldman, 27 Jan. 1906 (USNM). La Laguna, Sierra Laguna, elev. ca. 6,500–6,800 ft [1,980–2,070 m], C. C. Christensen, W. B. Miller, 31 Dec. 1973–1 Jan. 1974 (CCC, WBM). "Laguna Valley," elev. 5,000 ft [1,520 m], H. E. Gates, 21 Mar. 1931 (SBMNH). Several localities along trail from La Burrera to La Laguna, elev. 2,000–6,800 ft [610–2,070 m], C. C. Christensen, W. B. Miller, 1–2 Jan. 1974 (CCC, WBM). Sierra Laguna, trail on ridge above Las Animas, E. S. Ross, 13 Oct. 1941 (CAS). Along road to La Burrera 5.6 and 7.0 mi [9.0 and 11.2 km] E of Todos Santos-Cabo San Lucas road, C. C. Christensen, J. A. Christensen, Dec. 1975 (CCC). Along road to La Burrera 5.2–5.3 mi [8.3–8.5 km] E of Todos Santos-Cabo San Lucas road, C. Church, 21 Dec. 1970 (WBM); W. B. Miller, 30 Dec. 1973 (WBM). Along road to Horconsitos 6.7 mi [10.7 km] E of Todos Santos-Cabo San Lucas road, C. Church, 22 Dec. 1970 (WBM). 1.3 mi [2.1 km] S of Todos Santos, elev. ca. 100 ft [30 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM).

A record of this species near San Javier ("along road from Loreto to San Javier 6 mi [9.6 km] E of San Javier, C. Church, 11 Dec. 1970" [Delaware Museum of Natural History; CCC ex DMNH]) has not been confirmed despite extensive field work in that region by others; we believe the specimens to be mislabeled.

Rabdotus (Rabdotus) pilula (Binney, 1861)

(Fig. 22)

SYNONYMS.—*Bulimulus cooperi* "Dall" Cooper, 1895. *Bulimulus cooperi* Dall, 1896.

DISTRIBUTION.—BAJA CALIFORNIA SUR: "Habitat in paeninsulae Californiae, ad Todos Santos Mission, et in insula Margarita [Margarita]" (Binney 1861). San José del Cabo (Cooper 1891). Mts. near La Paz. G. Eisen, 1893 (USNM). Laguna Ranch, 8 mi [13 km] E of San José del Cabo, H. E. Gates, 3 Mar. 1931 (SBMNH, CCC, WBM). 2.4 mi [3.8 km] N of Cabo San Lucas, A. G. Smith, CAS 1959 Exped. (CAS). 5.4 mi [8.6 km] ENE of Cabo San Lucas, road to San José del Cabo, A. G. Smith, 17 Jan. 1959 (CAS).

No type locality was designated in the original description of *R. pilula*. Binney and Bland (1869) selected three specimens from "Todos [Santos] Mission" as "types." Binney's (1861) record of this species from Isla Margarita is undoubtedly in error. All recently collected specimens seen by us were collected in the Cabo San Lucas–San José del Cabo region.

Rabdotus (Rabdotus) sufflatus (Gould in Binney, 1859)

(Fig. 23)

SYNONYMS.—*Bulimulus vesicalis* Gould, 1853 (non *B. vesicalis* Pfeiffer, 1853). *Bulimus juarezi* Pfeiffer, 1865. *Bulimulus sufflatus* var. *insularis* Cooper, 1892. *Bulimulus insularis* var. *chinchensis* Cooper, 1894. *Bulimulus (Globulus) recognitus* Mabile, 1895.

DISTRIBUTION.—BAJA CALIFORNIA SUR: "In provincia pacifica reipublicae Mexicanae" (Pfeiffer 1865; TL of *Bulimus juarezi*). "Basse Californie." L. Diguët (Mabile 1895; TL of *Bulimulus (Globulus) recognitus*; MNHN). El Chinche Mountains, elev. 2,000 ft (Cooper 1894; TL of *Bulimulus sufflatus* var. *chinchensis*). Along Transpeninsular Highway at km 69 N of Villa Insurgentes, among rocks to S of road, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC, WBM). Along Transpeninsular Highway 31 mi [50 km] N of Villa Insurgentes, in lava rockslides on S side of arroyo, W. B. Miller, 23 Oct. 1971 (WBM). Sandy plain 7 mi [11.2 km] W of La Paz, I. L. Wiggins, H. M. Hill, 25 Nov. 1946 (SBMNH). Dry wash E of La Paz, H. E. Gates, 9 Mar. 1930 (SBMNH). La Paz (TL, desig. by Emerson and Jacobson 1964), Maj. W. Rich (Johnson 1964; MCZ); L. Belding (USNM); M. E. Jones, Mar. 1928 (SBMNH). W shore of Ensenada de La Paz, W. B. Miller, 28 Oct. 1971 (WBM). 0.2–0.5 mi [0.3–0.8 km] E of Punta San Lorenzo, on sandy flats behind beach, C. C. Christensen, 6 Aug. 1974

(subfossil; CCC); C. C. Christensen, J. A. Christensen, 25 Dec. 1975 (subfossil; CCC). Hillside above road at Playa Coromuel, C. C. Christensen, 26 Oct. 1972 (CCC). Along La Paz–Los Planes road 9.3 mi [15.0 km] SE of main highway S of La Paz, elev. ca. 1,450 ft [440 m], J. D. Kudenov, R. S. Houston, W. B. Miller, 27 Oct. 1971 (WBM). Bahía de los Muertos, H. E. Gates, 13 Mar. 1930 (SBMNH). Punta Arena, W. E. Bryant (USNM). Punta Arena, under bushes on sandy hillside near beach, C. Church, 29 Dec. 1970 (WBM). Punta Arena de la Ventana, under bushes in sand behind beach, J. D. Kudenov, R. S. Houston, W. B. Miller, 27 Oct. 1971 (WBM). Ca. 1 mi [1.6 km] inland from lighthouse at Punta Arena de la Ventana, C. C. Christensen, J. A. Christensen, 18 Dec. 1975 (CCC). Ensenada de los Muertos, under agaves, H. N. Lowe, Jan. 1932 (ANSP). Puerto de la Bahía de los Muertos, W. B. Miller, 27 Oct. 1971 (WBM). 7 mi [11 km] S of San Pedro, 2 mi [3.2 km] W of highway on road to El Carrizal, C. Church, Nov. 1969 (UA). 1.9 mi [3.1 km] W of La Paz–Todos Santos road, 7.2 mi [11.6 km] S of junction with La Paz–El Triunfo road, elev. 900 ft [270 m], C. C. Christensen, J. A. Christensen, 19 Dec. 1975 (CCC). Along road from Valle Perdido to ranch at Bajada del Molino, 2.0 mi [3.2 km] E of Bajada del Molino, in large arroyo S of road, elev. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1975 (CCC). Pedricitos Ranch, 23°40'N, 110°10'W, H. E. Gates, 27 Mar. 1931 (SBMNH). San Antonio, H. E. Gates, 12 Mar. 1930 (SBMNH). 2.5 mi [4.0 km] from San Antonio on road to Los Planes, C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC). Along San Antonio–San Bartolo road 3.9 mi [6.3 km] NE of San Antonio, elev. 1,800 ft [550 m], C. C. Christensen, J. A. Christensen, 19 Dec. 1975 (CCC). Along San Antonio–San Bartolo road 5.9 mi [9.5 km] E of San Antonio, C. C. Christensen, 10 Aug. 1974 (CCC). Along San Antonio–San Bartolo road 12.5 mi [20.1 km] NW of San Bartolo, W. B. Miller, 16 Dec. 1973 (WBM). 1.4 mi [2.3 km] from main highway at San Bartolo along road to microwave station, among granite boulders in steep ravine above the town, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC). Ca. 1.8 mi [2.9 km] SE of San Bartolo, along S side of arroyo, elev. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Along road from Las Palmas to El Cardonal and Punta Pescadores 5.8 mi [9.3 km] from main highway at Las Palmas, W. B. Miller, 20 Dec. 1973 (WBM). Along San Bartolo–Santiago road 9.8 mi [15.8 km] S of Rancho Buena Vista, C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). Ca. 0.5 mi [0.8 km] beyond El Coro (near Rancho Buena Vista) along trail leading up canyon into mountains, elev. ca. 1,000 ft [300 m], W. B. Miller, W. B. Miller III, 18 Dec. 1973 (WBM). Rancho La Laguna, H. E. Gates, 3 Mar. 1931 (SBMNH). Sierra Laguna, near Cabo San Lucas, G. Eisen (USNM). Las Animas Ranch, Sierra Laguna, E. Hammerly, E. S. Ross, 12 Oct. 1941 (CAS). Along trail from La Burrera to La Laguna, 2,000–3,000 ft [610–910 m], W. B. Miller, 2 Jan. 1974 (WBM). West slope of Sierra La Laguna, elev. 3,000 ft [910 m], H. E. Gates, 21 Mar. 1930 (SBMNH). Along road to La Burrera 0.6 mi [1.0 km] SW of La Burrera, W. B. Miller, 30 Dec. 1970 (WBM). Along road to La Burrera 0.8 mi [1.3 km] SW of La Burrera, elev. 1,900 ft. [580 m], C. C. Christensen, W. B. Miller, 30 Dec. 1973 (CCC, WBM). Along road to La Burrera 2.0 mi [3.2 km] SW of La Burrera, W. B. Miller, 30 Dec. 1973 (WBM). Along road to La Burrera 13.0 mi [20.9 km] E of Todos Santos–Cabo San Lucas road, C. C. Christensen, J. A. Christensen, W. B. Miller, 30 Dec. 1973 (CCC). Along road to La Burrera 7.0 mi [11.3 km] E of Todos Santos–Cabo San Lucas road, elev. 1,000 ft [300 m],

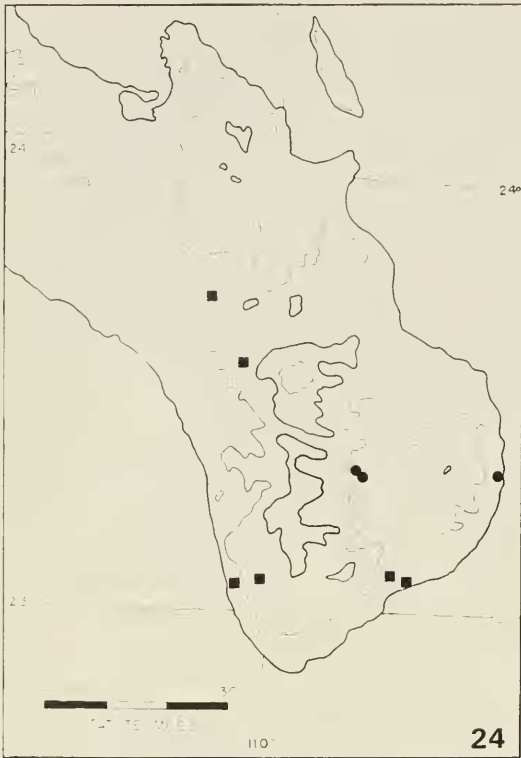


FIGURE 24. Distribution of *Rabdotus abbreviatus* (circles) and *Rabdotus ramentosus* (squares).

C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Along road to La Burrera 5.6 mi [9.0 km] E of Todos Santos—Cabo San Lucas road, C. C. Christensen, J. A. Christensen, W. B. Miller, 29–30 Dec. 1973 (CCC). Along road to La Burrera 5.3 mi [8.5 km] E of Todos Santos—Cabo San Lucas road and 1.0 mi [1.6 km] E of junction with road to Los Horconitos, W. B. Miller, 30 Dec. 1973 (WBM). Along road to La Burrera 8.0 mi [12.9 km] E of Todos Santos—Cabo San Lucas road, C. Church, 22 Dec. 1970 (WBM). Along road to Los Horconitos 6.7 mi [10.8 km] E of Todos Santos—Cabo San Lucas road, C. Church, 22 Dec. 1970 (WBM). Boca de la Sierra, along trail in arroyo W of village, elev. 1,000–1,600 ft [300–490 m], W. B. Miller, 26 Dec. 1970 (WBM). Boca de la Sierra, 1–2 mi [1.6–3.2 km] above village, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). 1.5 mi [2.4 km] E of Boca de la Sierra along road to Miraflores, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). Miraflores, H. E. Gates, 15 Mar. 1930 (SBMNH). Along Todos Santos—Cabo San Lucas road 3.1 mi [5.0 km] S of Las Piedritas, C. C. Christensen, J. A. Christensen, 20 Dec. 1975 (CCC). Rancho Cañada Honda, between Todos Santos and coast road, J. T. Smith, 15 Mar. 1984 (SBMNH). Along Todos Santos—Cabo San Lucas road 2.1–2.2 mi [3.4–3.5 km] N of El Saucito, elev. ca. 1,500 ft [460 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (CCC, WBM). Sierra El Taste, elev. 3,200 ft [980 m], G. Eisen, F. H. Vaslit (USNM). 0.3 mi [0.5 km] E of Santa Catarina—Los Frailes road at point 5.3 mi [8.5 km] S of Los

Frailes, elev. 50 ft [15 m], C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC). Along Santa Catarina—Los Frailes road 20.1 mi [32.3 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC). 1.1 mi [1.8 km] S of Rancho Los Dedos (ca. 6.5 mi [10.5 km] SE of Santa Catarina), C. C. Christensen, J. A. Christensen, W. B. Miller, 23 Dec. 1973 (CCC, WBM). Along Santa Catarina—Los Frailes road 3.2 mi [5.1 km] E of Santa Catarina, in rock outcrops on NW side of wash, C. C. Christensen, W. B. Miller, 23, 26 Dec. 1973 (CCC). Hills at Cabo San Lucas, H. E. Gates, 28 Feb. 1931 (SBMNH). Isla San José: Bahía Amortajada, G. D. Hanna et al., 24 Mar 1953, ORCA Exped. (CAS); W side of island, C. F. Harbison, I. L. Wiggins, 12 Apr. 1962 (SDMNH). Isla Espíritu Santo, W. E. Bryant (Cooper 1892b, TL of *Bu-limulus sufflatus* var. *insularis*; USNM); SE end of island, on desert floor, M. W. Williams, 18 Apr. 1937 (probably subfossil; SBMNH). Isla Cerralvo, R. C. Banks, 26 May–1 June 1962 (CAS); S end of island, J. P. Figg-Hoblyn, 1–2 Apr. 1952 (SBMNH).

Subgenus *Plicolumna* Cooper, 1895

Rabdotus (Plicolumna) abbreviatus (Cooper, 1892)

(Fig. 24)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Sierra Laguna (TL) (Cooper 1892b). Sierra El Taste, elev. ca. 4,200 ft [1,300 m], G. Eisen (Cooper 1894). San Lázaro, G. Eisen, F. H. Vaslit (USNM). Along trail above Boca de la Sierra, elev. 1,000–1,600 ft [300–490 m], W. B. Miller, 26 Dec. 1970 (WBM); C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). 0.3 mi [0.5 km] E of Santa Catarina—Los Frailes road, 5.3 mi [8.5 km] S of Los Frailes, C. C. Christensen, J. A. Christensen, 24 Dec. 1975 (CCC).

Rabdotus (Plicolumna) artemisia (Binney, 1861)

(Fig. 25)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Cabo San Lucas (TL), J. Xántus (Binney 1861; USNM). Sierra Laguna, elev. 3,000 ft [910 m] (Cooper 1892b). Sierra El Taste, elev. 3,400–4,200 ft [1,040–1,280 m], G. Eisen (Cooper 1894; USNM). Sierra San Lázaro, G. Eisen (Cooper 1895; USNM). Mts. E of La Paz, H. N. Lowe, Feb. 1929 (ANSP). Sierra Cacachila, along La Paz—Los Planes road 9.3 mi [15.0 km] SE of La Paz—Todos Santos road, elev. ca. 1,450 ft [440 m], R. S. Houston, J. D. Kudenov, W. B. Miller, 27 Oct. 1971 (WBM). Sierra Cacachila, along La Paz—Los Planes road 2.1 mi [3.4 km] SE of La Huerta and 14.4 mi [23.2 km] SE of La Paz—Todos Santos road, elev. 2,100–2,600 ft [640–670 m], C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). Sierra Cacachila, along La Paz—Los Planes road 15.5 mi [24.9 km] W of Los Planes, C. Church, 30 Dec. 1970 (WBM). Sierra Cacachila, along La Paz—Los Planes road 20.2 mi [32.5 km] SE of La Paz—Todos Santos road, elev. ca. 2,250 ft [690 m], R. S. Houston, J. D. Kudenov, W. B. Miller, 27 Oct. 1971 (WBM). 12.1 mi [19.5 km] NW of San Bartolo, A. G. Smith, 9 Jan. 1959 (CAS). 1.4 mi [2.3 km] from main highway along access road to microwave station at San Bartolo, among granite boulders in deep ravine above town, elev. ca. 1,400 ft [430 m], W. B. Miller, 19 Dec. 1973 (WBM); C. C. Christensen, W. B. Miller, 8 Dec. 1974, Ca. 0.6 mi [1.0 km] SE of San Bartolo, among large granite boulders



FIGURE 25. Distribution of *Rabdotus artemisia* (except for occurrence on Isla Espiritu Santo) (circles) and *Rabdotus perhirsutus* (squares).

along S side of arroyo, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Along road to La Burrera 0.6 mi [1.0 km] SW of La Burrera, W. B. Miller, 30 Dec. 1973 (WBM). Along Todos Santos–Cabo San Lucas road 3.1 mi [5.0 km] S of Las Piedritas and ca. 19.8 mi [31.9 km] S of Todos Santos, C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of Las Barrancas, elev. 500 ft [150 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, elev. 1,500 ft [460 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (CCC). Cabo San Lucas, H. N. Lowe, 1929 (ANSP). Mountains immediately behind Cabo San Lucas, ca. 0.25 mi [0.4 km] W of N end of town of San Lucas, C. C. Christensen, J. A. Christensen, W. B. Miller, 24 Dec. 1974 (CCC, WBM). Northernmost seaward-facing slope of Punta Los Frailes, elev. ca. 300 ft [90 m], C. Church, 27 Dec. 1970 (WBM). Along Santa Catarina–Los Frailes road 25.6 mi [41.2 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC). Same road, 23.4 mi [37.7 km] NE of Santa Catarina, elev. 550 ft [170 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC, WBM). E of Arroyo San José, NE of Santa Anita, J. T. Smith, 1985 (SBMNH). Isla Espiritu Santo: NE end of island, J. Ball, G. D. Hanna, 1953 ORCA Exped. (CAS); canyon back of Candelero Bay, A. G. Smith, 30 Aug. 1960 (CAS). Isla

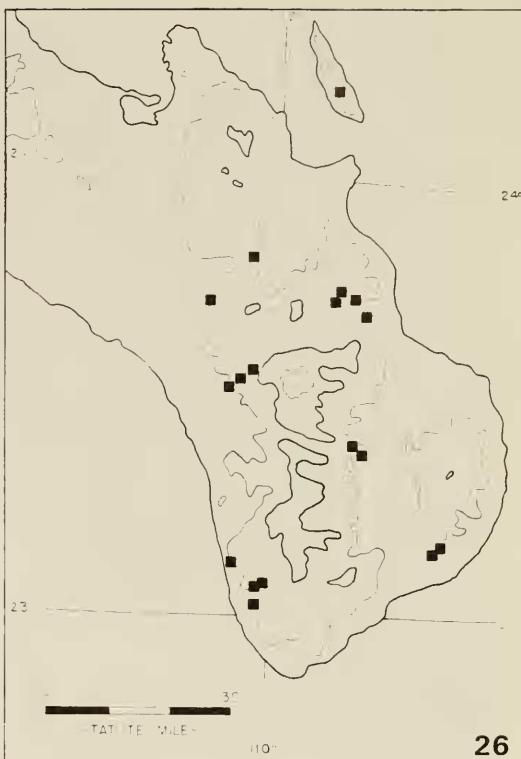


FIGURE 26. Distribution of *Rabdotus inscendens*.

Cerralvo, SW anchorage, 1 mi [1.6 km] SE of Piedras Blancas Point, elev. 1,500 ft [460 m], G. D. Hanna, 1953 ORCA Exped. (CAS).

***Rabdotus (Plicolumna) inscendens* (Binney, 1861)** (Fig. 26)

DISTRIBUTION.—BAJA CALIFORNIA SUR: 3 mi [4.8 km] SE of San Antonio, M. D. Robinson, 12 July 1970 (UA). Along road from Valle Perdido to ranch at Bajada del Molino 2.0 mi [3.2 km] by road from Bajada del Molino, in rockslides on N-facing slope of large arroyo S of road, elev. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1973 (CCC, WBM). 1.4 mi [2.3 km] from main highway at San Bartolo along road to microwave station, in deep ravine above town, elev. ca. 1,400 ft [430 m], W. B. Miller, 19 Dec. 1973 (WBM); C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC, WBM). 0.6 mi [1.0 km] SE of San Bartolo, along S side of arroyo, among large granite boulders, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). Ca. 1.8 mi [2.9 km] SE of San Bartolo, along S side of arroyo, among granite boulders, elev. ca. 800 ft [240 m], W. B. Miller, 28 Dec. 1970 (WBM). 3.7 mi [6.0 km] SE of San Bartolo, small arroyo entering San Bartolo arroyo from N, C. C. Christensen, J. A. Christensen, 21 Dec. 1973 (CCC). 5.7 mi [9.2 km] SE of San Bartolo, along S side of arroyo, among granite boulders, C. C. Christensen, 25 Dec. 1975 (CCC). Ca. 0.5 mi [0.8 km] beyond El Coro (near Rancho Buena Vista) along trail leading up canyon into mountains,

elev. ca. 2,000 ft [610 m], W. B. Miller, W. B. Miller III, 18 Dec. 1973 (WBM). Along trail from La Burrera to La Laguna, elev. 3,000 ft [910 m], W. B. Miller, 2 Jan. 1974 (WBM). Along trail from La Burrera to La Laguna, elev. 4,500–6,800 ft [1,370–2,070 m], C. C. Christensen, W. B. Miller, 1 Jan. 1974 (CCC, WBM). 0.6 mi [1.0 km] SW of La Burrera, in rocks along wash, W. B. Miller, 30 Dec. 1973 (WBM). Along road from Todos Santos to La Burrera, 8.1 mi [13.0 km] NE of junction with road to Los Horconitos, in rocks above arroyo, C. Church, 22 Dec. 1970 (WBM). Along trail W of Boca de la Sierra, elev. 1,000–1,600 ft [300–490 m], W. B. Miller, 26 Dec. 1970 (WBM). Along trail 1–2 mi [1.6–3.2 km] W of Boca de la Sierra, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC, WBM). Sierra San Lázaro, elev. 5,000 ft [1,520 m], G. Eisen (USNM). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of Las Barrancas, elev. 500 ft [150 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Arroyo Candelaria 2.1 mi [3.4 km] SW of La Candelaria, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria 2.3 mi [3.7 km] NE of Migriño, elev. 200 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Arroyo Candelaria at Migriño, C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, granite rockpiles at crest of small hill seaward of road, elev. ca. 1,500 ft [460 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM); C. C. Christensen, W. B. Miller, 22 Dec. 1973 (CCC, WBM); C. C. Christensen, 9 Aug. 1974 (CCC). Along Todos Santos–Cabo San Lucas road 2.1 mi [3.4 km] N of El Saucito, among granite rocks inland of road, elev. ca. 1,500 ft [460 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (CCC); C. C. Christensen, J. A. Christensen, 22 Dec. 1975 (CCC). 0.8 mi [1.3 km] N of Los Pozos, C. Church, Nov. 1969 (WBM). Along Santa Catarina–Los Frailes road 15.6 mi [25.1 km] NE of Santa Catarina, C. C. Christensen, J. A. Christensen, W. B. Miller, 26 Dec. 1973 (CCC, WBM). Along road from San José del Cabo to Los Frailes 4.2 mi [6.8 km] E of La Escopita, C. Church, 26 Dec. 1970 (WBM). Cape St. Lucas, J. Xántus (USNM). Granite outcrops of gravelly hills 9 mi [12.6 km] NE of Cabo San Lucas. H. E. Gates, 22 Mar. 1930 (SBMNH). Isla Cerralvo, CAS 1921 Exped. (CAS).

***Rabdotus (Plicolumna) perhirsutus* Miller, Christensen, and Roth, sp. nov.**

(Fig. 25)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Arroyo Candelaria, 2.3 mi [3.7 km] E of Migriño, elev. 200 ft [60 m], C. C. Christensen, 21 Dec. 1975 (CCC). Along Todos Santos–Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito, elev. ca. 1,500 ft [460 m] (TL), W. B. Miller, W. N. Miller, 23 Dec. 1970 (SBMNH); C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973 (SBMNH, ANSP, BR, CAS, CCC, LACM, SDMNH, USNM); C. C. Christensen, 9 Aug. 1984 (CCC).

***Rabdotus (Plicolumna) ramentosus* (Cooper, 1891)**

(Fig. 24)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Mountains N of San José del Cabo, W. E. Bryant (TL, fide Cooper 1892a). Foothills near San José del Cabo, G. Eisen (Cooper 1893; USNM). Along Santa Catarina–Los Frailes road 3.2 mi [5.1

km] NE of Santa Catarina, C. C. Christensen, W. B. Miller, 23, 26 Dec. 1973 (Christensen and Miller 1975; CCC, WBM). Along road from Valle Perdido to ranch at Bajada del Molino, 2.0 mi [3.2 km] E of Bajada del Molino, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28–29 Dec. 1973 (CCC, WBM). Along trail from La Burrera to La Laguna, elev. ca. 3,000 ft [910 m], W. B. Miller, 2 Jan. 1974 (WBM). Arroyo Candelaria, 2.1 mi [3.4 km] W of Candelaria, elev. ca. 300 ft [90 m], C. C. Christensen, 22 Dec. 1975 (CCC). Arroyo Candelaria at Migriño, C. C. Christensen, 21 Dec. 1975 (CCC). Sierra San Lázaro, G. Eisen (ANSP; USNM). 0.6 mi [1.0 km] SW of Rancho La Laguna and ca. 6 mi [9.6 km] NW of San José del Cabo, elev. 300 ft [90 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC).

Subgenus uncertain

***Rabdotus*(?) sp.**

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Carmen, Oto Bay, just E of main arroyo entering bay, Pleistocene (Durham 1950, as *Bulimulus* sp.; Univ. California [Berkeley] Mus. Paleo. 32892).

The single specimen is an external mold in coarse sandstone matrix of the spire of a species of *Rabdotus* or perhaps *Naesiotus*, but not further identifiable.

Genus *Berendtia* Crosse and Fischer, 1869

***Berendtia taylori* (Pfeiffer, 1861)**

(Fig. 27)

SYNONYM.—*Cylindrella (Urocoptis) newcombiana* Gabb, 1868.

DISTRIBUTION.—BAJA CALIFORNIA SUR: “Hidden under loose volcanic rocks in the high table lands of the interior of Lower California, especially about Moleje [Mulegé],” W. M. Gabb, 1867 (Gabb 1868; H. B. Baker 1963; Coan and Bogan 1988; TL of *Cylindrella newcombiana*; ANSP). Canyon back of Puerto Escondido, I. M. Johnston, J. C. Chamberlin, CAS 1921 Exped. (Hanna 1923; CAS, SBMNH). Puerto Escondido, H. N. Lowe, 1931 (Lowe 1933). Rocky slope of side canyon at Comondú Viejo, H. E. Gates, 9 Apr. 1930 (SBMNH). San José Comondú, R. J. Drake, July 1953 (CAS, SBMNH). San José Comondú, elev. 1,200 ft [360 m], W. N. Miller, W. B. Miller, 20 Dec. 1970 (WBM). Pacific slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta to Guajademi, in rockslide ca. 0.75 mi [1.2 km] S of trail summit, elev. 2,300 ft [700 m], C. C. Christensen, W. B. Miller, 23 Oct. 1972 (CCC). Along Canipolé–San José Comondú road 10 mi [16 km] SW of Canipolé, elev. ca. 1,000 ft [300 m], W. N. Miller, W. B. Miller, 20 Dec. 1970 (WBM). 12.6 mi [20.2 km] E of La Purísima, along road to Canipolé, C. Church, 10 Jan. 1971 (WBM). Arroyo de la Purísima, 12 mi [19 km] S of Canipolé, I. L. Wiggins, H. M. Hill, 17 Nov. 1946 (SBMNH). Arroyo de la Purísima, in rockslide S of road 3.0 mi [4.8 km] NE of San Isidro, elev. 600 ft [180 m], W. N. Miller, W. B. Miller, 21 Dec. 1970 (Christensen and Miller 1975; WBM). Rockslide W of Transpeninsular Highway 2.7 mi [4.3 km] N of turnoff to Loreto, C. C. Christensen, S. Kessler, 30 July 1974 (CCC). San Javier, in rockslide immediately S of mission, elev.

1,200–1,500 ft [370–460 m], C. C. Christensen, W. B. Miller, 25 Oct. 1972 (Christensen and Miller 1975; CCC). 1.0 mi [1.6 km] S of Chuenque, C. Church, 8 Dec. 1970 (WBM). Along Transpeninsular Highway at km 69 N of Villa Insurgentes, C. C. Christensen, W. B. Miller, 5 Dec. 1974. Along Transpeninsular Highway 31 mi [50 km] N of Villa Insurgentes, elev. 900 ft [270 m], W. B. Miller, 23 Oct. 1971 (WBM).

Berendtia is a monotypic genus restricted to the Sierra de la Giganta. Living snails may be found sealed to the undersides of rocks in the numerous large accumulations of lava talus in this area. Although formerly placed in Urocopitidae and made the type-genus of a new subfamily, Berendtinae, by Fischer and Crosse (1872 [1870–1902]), *Berendtia* is anatomically similar to *Rabdotus* and *Spartocentrum* (Christensen and Miller 1975a). *Berendtia taylori*, described from an unknown locality, was recognized as Baja Californian by Bland (1870). Breure (1978, 1979) described the radula and gave additional anatomical notes.

Genus *Spartocentrum* Dall, 1895

Spartocentrum digueti (Mabille, 1895)

(Fig. 28)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Plateaus above Arroyo de la Purissima [Purísima] (TL) [type lot labeled “Plateau de San Javier,” fide Breure 1978], L. Diguët (Mabille 1895; MNHN).

This species has not been collected since its discovery by Diguët. Breure (1978) redescribed and illustrated specimens from the type lot at the MNHN. *Spartocentrum digueti* is the type species, by designation of Breure (1979), of *Teneritia* Mabille 1897, a junior synonym of *Spartocentrum*.

Spartocentrum eisenianum (Pilsbry, 1900)

DISTRIBUTION.—“Lower California” (TL), F. L. Button (Pilsbry 1900, 1902–1903; ANSP). BAJA CALIFORNIA SUR: Cabo San Lucas, G. Eisen (Bartsch 1906, as *Coelocentrum* [*Spartocentrum*] *eiseni* Pilsbry).

This species has not been collected recently; it is known only from one specimen. We seriously doubt the occurrence of any species of *Spartocentrum* in the Cape region of Baja California.

Spartocentrum insulare (Hanna, 1923)

(Fig. 28)

SYNONYM.—*Coelocentrum oweni* Hanna, 1923.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Carmen, Puerto Bellandra [Balandra] (TL), F. Baker, V. Owen, 21 May

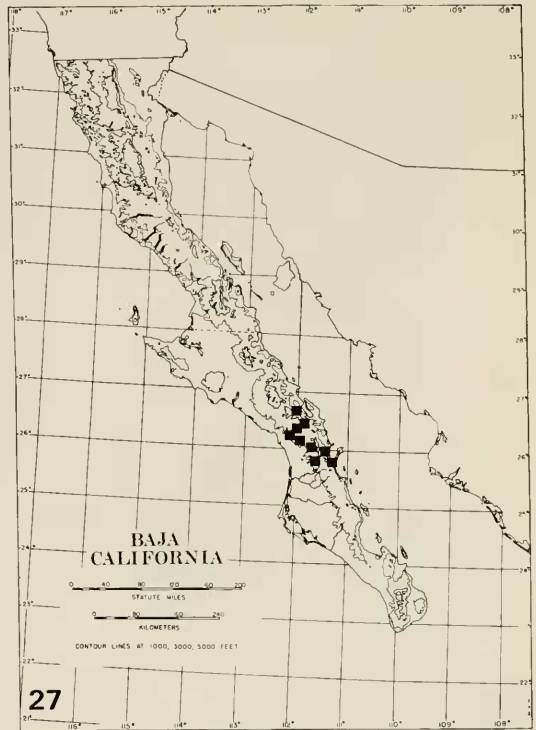


FIGURE 27. Distribution of *Berendtia taylori*.

1921. CAS 1921 Exped. (Hanna 1923; CAS, SBMNH); C. C. Christensen, 1 Aug. 1974 (CCC, WBM). Isla Carmen: Bahía Marquer, E. P. Van Duzee, J. C. Chamberlin, CAS 1921 Exped. (Hanna 1923; CAS); W. K. Emerson et al., 1962, Belvedere Exped. (Emerson and Jacobson 1964, as *Coelocentrum oweni*); Agua Grande, V. Owen, 15 June 1921, CAS 1921 Exped. (Hanna 1923; TL of *Coelocentrum oweni*; CAS, SBMNH). Isla Monserrate, J. C. Chamberlin, CAS 1921 Exped. (Hanna 1923; CAS). Isla Danzante, F. Baker, I. M. Johnston, CAS 1921 Exped. (Hanna 1923; CAS); H. N. Lowe, 1931 (Lowe 1933); W. K. Emerson et al., 1962, Belvedere Exped. (Emerson and Jacobson 1964, as *Coelocentrum oweni*); P. Turk, 4–8 Jan. 1978 (CCC, WBM). Isla Santa Catalina, CAS 1921 Exped. (Hanna 1923; CAS).

Spartocentrum irregulare (Gabb, 1868)

(Fig. 28)

SYNONYMS.—*Berendtia minorina* Mabille, 1895. *Coelocentrum minorinum gabbi* Pilsbry, 1900. *Coelocentrum clavigeroi* Hanna, 1923.

DISTRIBUTION.—BAJA CALIFORNIA SUR: “Table lands in the interior of Lower California, especially about Moleje [Mulegé]” (TL), W. M. Gabb, 1867 (Gabb 1868; Pilsbry 1900; Coan and Bogan 1988; ANSP, CAS, USNM); same data for type lot of *Coelocentrum minorinum gabbi* Pilsbry (1900; ANSP). Along road from Santa Rosalía to San José de Magdalena, at 20.8 mi [33.3 km] from Mexico Highway 1, W. B. Miller, 4 Jan. 1974 (WBM). Along road from Rosarito to Bahía San Nicolás, at 5.3 road mi [8.5 km] from San Nicolás, W. B.

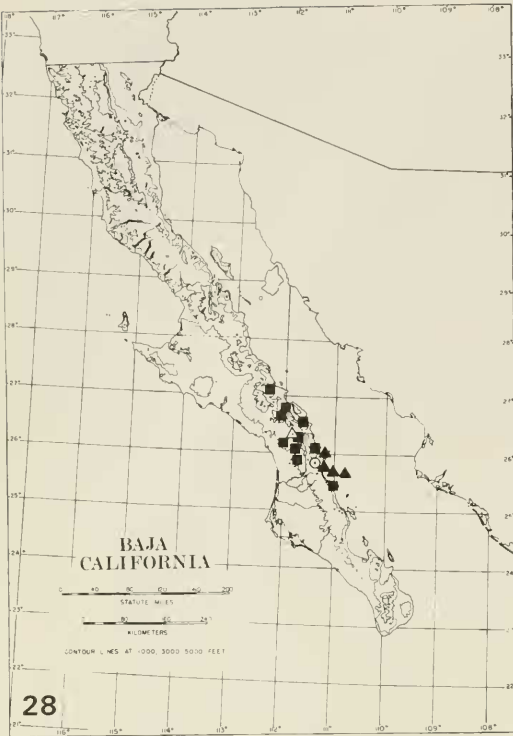


FIGURE 28. Distribution of *Spartocentrum digueti* and *Spartocentrum* sp. (open triangle), *Spartocentrum insulare* (solid triangles), *Spartocentrum irregulare* (squares), and *Spartocentrum vanduzeei* (open circle).

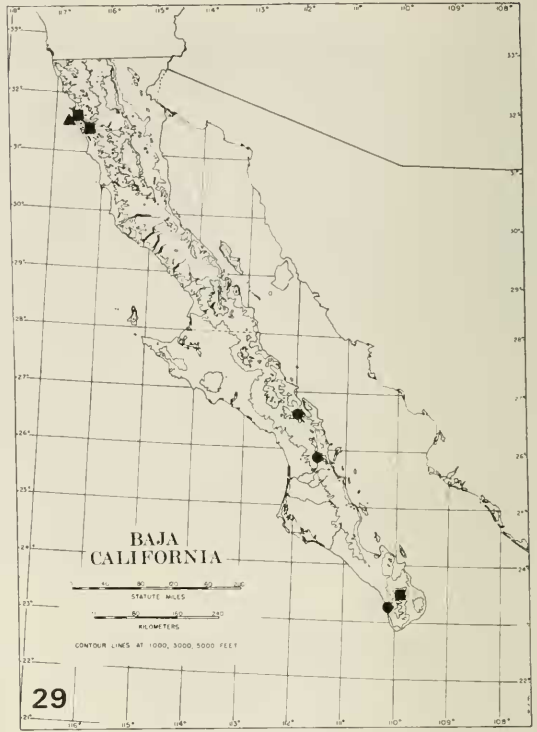


FIGURE 29. Distribution in Baja California of *Paraloama caputspinulae* (triangle), *Deroceras laeve* (squares), and *Ha-waia* sp. (circles).

Miller, C. C. Christensen, 5 Dec. 1974 (CCC, WBM). El Potrero Ranch, SW of Mulegé, H. E. Gates, 31 Mar. 1931 (SBMNH). E slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta (2.9 mi [4.6 km] S of El Potrero) to Guajademi, elev. ca. 2,100 ft [640 m]. C. C. Christensen, W. B. Miller, 22–23 Oct. 1972 (CCC, WBM). Guajademi, E. W. Nelson, E. A. Goldman (Bartsch 1906, as *Coelocentrum* [*Spartocentrum*] *minorinum gabbi*). San José Comondú, R. J. Drake, July 1953 (SBMNH); at edge of town, in canyon leading to San Javier, elev. ca. 1,200 ft [360 m], W. N. Miller, W. B. Miller, 20 Dec. 1970 (WBM). Along Canipolé–San José Comondú road, 10 mi [16 km] from Canipolé, elev. ca. 1,000 ft [300 m], W. N. Miller, W. B. Miller, 20 Dec. 1970 (WBM). 6.5 mi [10.4 km] N of San Isidro (0.6 mi [1.0 km] S of Huerto Vieja), C. Church, Nov. 1969 (UA). Near Loreto, C. C. Christensen, S. Kessler, 30 July 1974 (CCC). Bahía Agua Verde, I. M. Johnston, 26 May 1921, CAS 1921 Exped. (Hanna 1923; TL of *Coelocentrum clavigeroi*; CAS). Arroyo de la Purísima, in cracks of shady cliff, I. L. Wiggins, H. M. Hill, 17 Nov. 1946 (SBMNH). Plateaus above Arroyo de la Purísima [Purísima], L. Diguet (Mabille 1895; TL of *Berendtia minorina*; MNHN). Along Mexico Highway 1 at a point 0.4 mi [0.6 km] N of km 105 (measured from La Paz), 6 Dec. 1974, W. B. Miller, C. C. Christensen (CCC, WBM). At km 77 along Mexico Highway 1 between La Paz and Ciudad Constitución, R. Houston, J. Kudenov, W. B. Miller, 23–26 Oct. 1971 (WBM); C. C. Chris-

tensen, 3 Aug. 1974 (CCC); W. B. Miller, C. C. Christensen, 6 Dec. 1974 (CCC, WBM).

The type locality of *Spartocentrum irregulare* was never clearly stated; Gabb (1868) only remarked that the species was in similar locations to his *Cylindrella newcombiana* (= *Berendtia taylori*). The holotype is in ANSP (H. B. Baker 1963); original lot or paratypic material is in CAS (Hanna 1923) and USNM (Bartsch 1906). We have compared the holotype of *Coelocentrum clavigeroi* with original lot material of *S. irregulare* in CAS and found them identical; therefore we place *C. clavigeroi* in synonymy.

The type lot of *Coelocentrum minorinum gabbi* was selected out of the original lot of *S. irregulare* by Pilsbry (1900).

Breure (1978) redescribed and illustrated type material of *Berendtia minorina* from the MNHN.

Spartocentrum vanduzeei (Hanna, 1923) (Fig. 28)

DISTRIBUTION.—BAJA CALIFORNIA SUR: W side of Puerto Escondido (TL), E. P. Van Duzee, 14 June 1921, CAS

1921 Exped. (Hanna 1923; CAS); H. N. Lowe, 1931 (Lowe 1933). Puerto Escondido, R. Moran, M. Soulé, 1962, Belvedere Exped. (Emerson and Jacobson 1964); under stones on arid hillside, T. Craig, 9 Mar. 1928 (SBMNH). Juncalito, W. B. Miller, 3 Jan. 1974 (CCC, WBM); C. C. Christensen, S. Kessler, 30 July 1974 (Christensen and Miller 1975a; CCC). 1 mi [1.6 km] S of Chuenque, C. Church, 8 Dec. 1970 (Christensen and Miller 1975; WBM).

Breure (1978) briefly described the radula and the histology of part of the reproductive system.

Spartocentrum sp.

(Fig. 28)

DISTRIBUTION.—BAJA CALIFORNIA SUR: San Javier, in lava rockslide immediately S of the Mission, elev. 1,200–1,500 ft [370–460 m], W. B. Miller, 24 Oct. 1971 (WBM); W. B. Miller et al., 25 Oct. 1972 (CCC). 0.6 mi [1.0 km] E of San Javier, C. Church, 11 Dec. 1970 (WBM). Along San Javier–Santo Domingo road, 9.8 mi [15.7 km] W of San Javier, C. Church, 12 Dec. 1970 (WBM).

One or more undescribed species occur in the vicinity of San Javier. Their description is postponed until more material is available.

Suborder AULACOPODA Superfamily ARIONOIDEA Family PUNCTIDAE

Genus *Paralaoma* Iredale, 1913

Paralaoma caputspinulae (Reeve, 1852)

(Fig. 29)

SYNONYMS.—*Helix conspecta* Bland, 1865. *Punctum conspectum pasadenae* Pilsbry, 1896.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Along road to Puerto Santo Tomás, 4.0 mi [6.4 km] from Transpeninsular Highway, a single specimen found in leaf litter, W. B. Miller, 27 Jan. 1962 (WBM).

This “weedy” species is very widely distributed, at least in part by human agency (Roth 1986, as *Punctum pusillum*, an invalid name [Roth 1987]). It is known also from Alaska, British Columbia, Idaho, Montana, Washington, Oregon, California, Arizona and New Mexico, and is recorded from Kamchatka (Bequaert and Miller 1973). A subspecies, *P. c. jaliscoense* (Pilsbry), occurs in Jalisco and México, D. F. This is the first record of the genus in Baja California.

Family HELICODISCIDAE Genus *Helicodiscus* Morse, 1864 Subgenus *Hebetodiscus* Baker, 1929

Helicodiscus (*Hebetodiscus*) *singleyanus* (Pilsbry, 1890)

(Fig. 30)

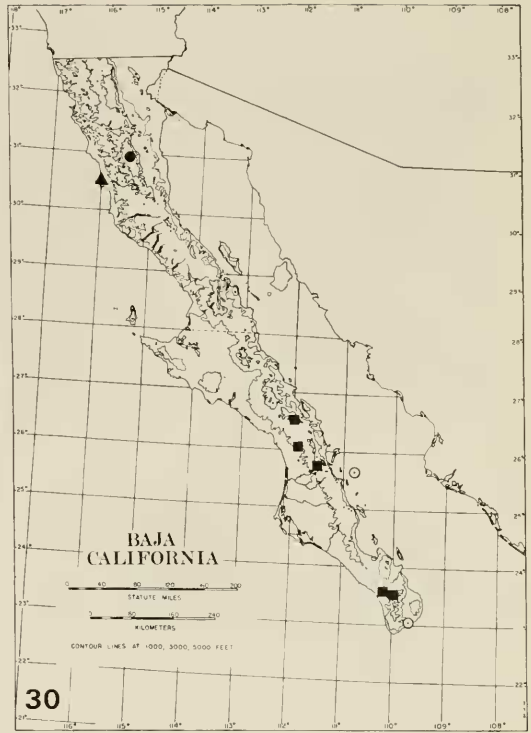


FIGURE 30. Distribution in Baja California of *Helicodiscus singleyanus* (open circles), *Binneya notabilis* (triangles), *Euconulus fulvus* (solid circles), and *Glyphyalinia indentata paucilirata* (squares).

SYNONYMS.—*Hyalinia laeviuscula* Sterki, 1892. *Hyalinia texana* Sterki, 1892 (nomen nudum).

DISTRIBUTION.—BAJA CALIFORNIA SUR: 0.2 mi [0.3 km] SSE of San José del Cabo, on road to La Playa, in stream drift, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS); the large series collected appears to belong to this species. (?) Isla Santa Catalina, G. D. Hanna, 1953 (CAS); three broken, worn, immature specimens.

This species also occurs from the southeastern U.S. north to New Jersey and Indiana, west to South Dakota, Colorado, New Mexico, and Arizona, and south to Sonora and Tamaulipas, Mexico; it is adventive in California (Bequaert and Miller 1973). This is the first record of the genus in Baja California.

Family ARIONIDAE Genus *Binneya* Cooper, 1863 Subgenus *Binneya* sensu stricto

Binneya (*Binneya*) *notabilis* Cooper, 1863

(Fig. 30)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: “Four living individuals . . . and one or two dead shells were found

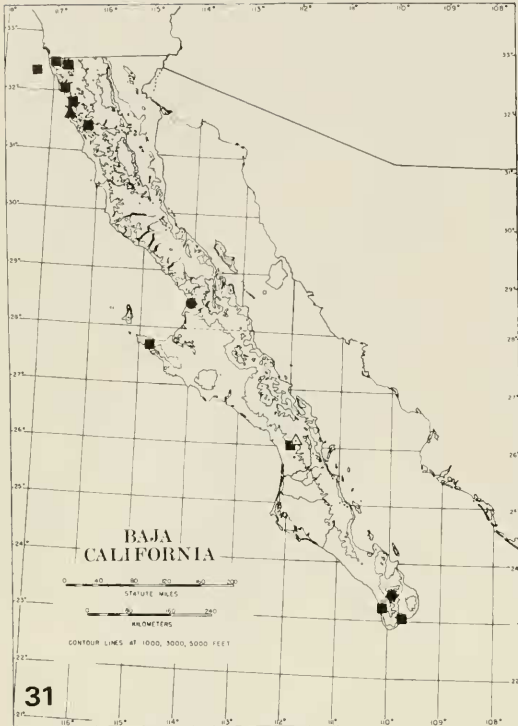


FIGURE 31. Distribution in Baja California of *Succinea californica* (solid triangle), *Succinea rusticana* (circles), *Catinella rehderi* (squares), and *Oxytoma nuttallianum* (open triangle).

under decaying trunks of the maguey (*Agave shawii*) at an elevation of a few hundred feet among the hills north of San Quentin bay [Bahía San Quintín],” by C. R. Orcutt, Apr. 1885 (Binney 1886b).

Pilsbry (1948) predicted that the form from Bahía San Quintín would turn out to be a species distinct from *B. notabilis* of Santa Barbara and San Nicolas islands, California. Live-collected material from Baja California, which would allow the critical comparisons to be made, has not been obtained recently.

Subgenus *Allothyra* Pilsbry, 1948

Binneya (Allothyra) guadalupensis Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe: G. W. Dunn, prior to 1884 (Anonymous 1884, as *B. notabilis*); W. E. Bryant, E. Palmer (Binney 1879; Cooper 1887, 1892a, as *B. notabilis*); A. W. Anthony, 1896 (Dall 1900, as *B. notabilis*); Templeton Crocker Exped., 16 Mar. 1932 (CAS); 3 mi [5 km] S of Northeast Anchorage (TL); Pine Ridge at elev. 3,000 ft [900 m]; and 2 mi [3.2 km] N of S end of island, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); Puerto

Norte, under rocks near shore and at elev. ca. 500 ft [150 m], W. L. Lee, 24–29 Dec. 1974 and 15 Feb. 1975 (CAS); West Anchorage, under rocks in arroyo bottoms, G. E. Lindsay, 30 Jan. 1950 (SBMNH).

Superfamily SUCCINEOIDEA Family SUCCINEIDAE Genus *Succinea* Draparnaud, 1801

Succinea californica Crosse and Fischer, 1878 (Fig. 31)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: San [Santo] Tomás (TL), H. Hemphill (Crosse and Fischer 1878). Santo Tomás Valley, W. B. Miller, 27 Jan. 1962 (WBM).

Miller collected this species in the vicinity of the type locality and confirmed its generic placement by dissection of living adult specimens.

Succinea guadalupensis Dall, 1900

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe (TL); A. W. Anthony, 1896 (Dall 1900); Pine Ridge, at elev. ca. 3,000 ft [900 m], G. D. Hanna, CAS 1922 Exped., fragments only (Pilsbry 1927; CAS).

Succinea rusticana Gould, 1846 (Fig. 31)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: South to 31°N, C. R. Orcutt (Cooper 1892b). Ojos Negros, slow stream through meadow, I. L. Wiggins, H. M. Hill, 3 Oct. 1946 (SBMNH). 55 km N of Guerrero Negro, under dead agave, C. C. Christensen, 1973 (CCC). BAJA CALIFORNIA SUR: Common in the Sierra Laguna, G. Eisen (Cooper 1892b).

These records need verification based on anatomical studies of live-collected animals. *Succinea rusticana* is reported also from British Columbia, Washington, Oregon, and California (Pilsbry 1948).

Genus *Catinella* Pease, 1871

Catinella rehderi (Pilsbry, 1948) (Fig. 31)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Lower California N of 31°N lat., C. R. Orcutt (Orcutt 1886, as *Succinea oregonensis*). Islas Los Coronados (CAS). Tecate Valley near the U.S. border, H. Hemphill (CAS). 4.5 mi [6.8 km] S of La Misión, elev. 500 ft [150 m], S. C. Williams, 1969 (CAS). Punta Banda, elev. 100 ft [30 m], S. C. Williams, V. F. Lee, 1969 (CAS). Stream bank W of Ensenada road about 9 mi [15 km] N of Santo Tomás, L. G. Ingles, 17 Dec. 1927 (Berry 1928, as *Succinea* sp.). 0.5 mi [0.8 km] N of San Vicente, elev. 300 ft [90 m], S. C. Williams, 1969 (CAS). San Telmo Mesa, under dead agave, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 10 Oct. 1946 (SBMNH). Brush 50 m back from beach, 25 mi [40 km] N of El Rosario, I. L. Wiggins, H. M. Hill, 23 Oct. 1946 (SBMNH). Miller's landing, under dead *Echinocereus mari-*

timus, I. L. Wiggins, H. M. Hill, 29 Oct. 1946 (SBMNH). Arroyo 9 mi [14 km] E of Miller's Landing, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). Under dead agaves, 8 mi [13 km] S of Miller's Landing, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). Under dead agaves, summit of mesa just S of Rancho Mezquital, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 30 Oct. 1946 (SBMNH). BAJA CALIFORNIA SUR: Bahía San Bartolomé [Bahía Tortugas], H. Hemphill (CAS). 12 mi [19 km] SW of San Miguel Comondú, probably fossil, R. J. Drake, July 1953 (CAS). Bahía San Pedrito, 3.9 mi [6.3 km] SE of Todos Santos, A. G. Smith, CAS 1958–1959 Exped. (CAS). In stream drift 0.2 mi [0.3 km] SSE of San José del Cabo, on road to La Playa, A. E. Leviton, A. G. Smith, CAS 1958–1959 Exped. (CAS).

Allocation of these specimens to *C. rehderi* is provisional. Authoritative identification of Baja California Succineidae, as previously indicated, must be based on anatomical studies. Shells with the general form of *C. rehderi* are known also from Montana and Washington to southern California (Pilsbry 1948).

Genus *Oxyloma* Westerlund, 1885

Oxyloma nuttallianum (Lea, 1841)

(Fig. 31)

DISTRIBUTION.—BAJA CALIFORNIA SUR: 12 mi [19 km] SW of San Miguel Comondú (possibly fossil), R. J. Drake, July 1953 (UA).

Oxyloma nuttallianum is reported to be widespread in western North America, but its range is not well defined. This is the first record of the genus in Baja California.

Superfamily LIMACOIDEA Family HELICARIONIDAE

Genus *Euconulus* Reinhardt, 1883

Euconulus fulvus (Müller, 1774)

(Fig. 30)

SYNONYMS.—*Helix trochiformis* Montagu, 1803. *Helix egena* Say, 1825. *Helix mortoni* Jeffreys, 1830. *Conulus fulvus alaskensis* Pilsbry, 1899.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Sierra San Pedro Mártir, elev. 8,800–9,000 ft [2,700–2,800 m], W. B. Miller, C. C. Christensen, Nov. 1973 (Miller 1981a; WBM).

Euconulus fulvus is distributed almost throughout the Holarctic realm.

Family ZONITIDAE

Genus *Glyphyalinia* von Martens, 1892

Glyphyalinia indentata paucilirata (Morelet, 1851)

(Fig. 30)

SYNONYM.—*Zonites indentatus* var. *umbilicatus* Cockerell, 1893.

DISTRIBUTION.—BAJA CALIFORNIA SUR: High on the Sierra Laguna, G. Eisen (Cooper 1892b). Sierra El Taste, G. Eisen, 1892 (Cooper 1894). Eastern slope of Sierra de la Giganta, ca. 1.0 mi [1.6 km] from Pie de la Cueta along trail to Guajademi, elev. 2,100–2,450 ft [640–750 m], C. C. Christensen, W. B. Miller, 22 Oct. 1972 (WBM). Lower arroyo 12 mi [19 km] SW of San Miguel Comondú (probably fossil), R. J. Drake, 1953 (CAS). San Javier, in rockslide immediately N of the mission, W. B. Miller, 24 Oct. 1971 (WBM). Along road from Valle Perdido to ranch at Bajada del Molino, in rockslides on N-facing slope of arroyo S of road, elev. ca. 1,400 ft [430 m], C. C. Christensen, 28, 29 Dec. 1973 (CCC). Summit of trail from La Burrera to La Laguna, in large rockslide, elev. ca. 6,800 ft [2,100 m], W. B. Miller, 1 Jan. 1974 (WBM). La Laguna, in rocks along creek at cabin, elev. ca. 6,500 ft [1,980 m], C. C. Christensen, W. B. Miller, 31 Dec. 1973 (CCC, WBM).

All cited specimens are assigned to this taxon provisionally. The recorded range of *G. i. paucilirata* includes the southeastern U.S., northern Mexico, and states as far west as Arizona and Utah, but western records may pertain to other taxa (W. L. Pratt, pers. comm., 1980).

Genus *Striatura* Morse, 1864

Subgenus *Pseudohyalina* Morse, 1864

Striatura (Pseudohyalina) pugetensis (Dall, 1895)

SYNONYM.—*Radiodiscus hubrichti* Branson, 1975.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe: hills above Northeast Anchorage, elev. ca. 1,000 ft [300 m]; and 2 mi [3.2 km] N of S end of island on E side, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Striatura pugetensis also ranges from British Columbia through Montana and Washington to southern California. It has been reported from Kauai, Hawaiian Islands (H. B. Baker 1941a, Pilsbry 1946).

Genus *Hawaiiia* Gude, 1911

Hawaiiia sp.

(Fig. 29)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Eastern slope of Sierra de la Giganta, 1.0 mi [1.6 km] from Pie de la Cueta (located 2.9 mi. S of El Potrero and ca. 20 mi S of Mulegé) along trail to Guajademi, elev. 2,100–2,450 ft [640–750 m], C. C. Christensen, W. B. Miller, 22 Oct. 1972 (WBM). San Javier, in rockslide immediately S of the mission, W. B. Miller, 24 Oct. 1971 (WBM). Bahía San Pedrito, 3.9 mi [6.3 km] SE of Todos Santos, A. G. Smith, CAS 1958–1959 Exped. (CAS).

A few specimens of a *Hawaiiia* have been found in the Sierra de la Giganta of Baja California Sur. Bequaert and Miller (1973) referred them to the species *H. minuscula*, but we refrain from assigning the Baja California material to a species pending completion of studies of western North American *Hawaiiia* by other workers.

Family LIMACIDAE
Genus *Deroceas* Rafinesque, 1820

Deroceas laeve (Müller, 1774)

(Fig. 29)

SYNONYMS.—*Limax* (*Eulimax*) *campestris* var. *occidentalis* Cooper, 1872. *Limax montanus* Ingersoll, 1875 (non Leydig, 1871). *Limax castaneus* Ingersoll, 1875. *Agriolimax montanus* forms *typicus*, *intermedius*, *tristis* Cockerell, 1888. *Limax hemphilli* Binney, 1890. *Limax hemphilli* var. *pictus* Binney, 1892. *Agriolimax campestris* var. *zonatipes* Cockerell, 1892. *Agriolimax hemphilli ashmuni* Pilsbry and Vanatta, 1910.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: San [Santo] Tomás, H. Hemphill (Binney 1890, as *Limax hemphilli*). San [Santo] Tomás River, H. Hemphill (Binney 1892, TL of *L. hemphilli* var. *pictus*; Cockerell 1897, as *Agriolimax berendii* var. *pictus*). 0.5 mi [0.8 km] N of San Vicente, elev. 300 ft [90 m], S. C. Williams, V. F. Lee, 1969 (CAS). BAJA CALIFORNIA SUR: La Laguna, Sierra de la Victoria, elev. 6,500 ft [1,980 m], W. B. Miller, C. C. Christensen, 31 Dec. 1973 (WBM).

The synonymy given for this Holarctic, often-named species is not intended to be complete but includes only nominal taxa with type-localities in western North America.

Cooper's (1892b) report of an unidentified *Limax* "from the mountains" may refer to *Deroceas laeve*, as may Orcutt's (1886) citation of a species from north of 31°N. Mabile's (1895) record of *Limax guatemalensis* Crosse and Fischer, 1870, from "dans les herbes au bord des torrents de la Laguna" may refer to *D. laeve*, which Miller and Christensen collected at La Laguna, Sierra de la Victoria.

Genus *Milax* Gray, 1855

Milax gagates (Draparnaud, 1801)

SYNONYM.—*Limax* (*Amalia*) *hewstoni* Cooper, 1872.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Near mouth of San [Santo] Tomás River, H. Hemphill (Hemphill 1881, Binney 1883, as *Limax hewstoni*).

This species is introduced from western Europe.

Suborder HOLOPODA
Superfamily POLYGYROIDEA
Family POLYGYRIDAE

Genus *Polygyra* Say, 1818
Subgenus *Erymodon* Pilsbry, 1956

Polygyra (*Erymodon*) *behri* (Gabb, 1865)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Sandy lowlands 0.2–0.5 mi [0.3–0.8 km] E of Punta San Lorenzo, C. C. Christensen, 6 Aug. 1974 (CCC).

A single empty shell of this mainland Mexican species (TL: near Guaymas, Sonora; Coan and Bogan 1988) was found just inland of the beach near Punta San Lorenzo, on the Baja California peninsula northeast of La Paz. It was found with apparently subfossil shells of *Rabdotus sufflatus* and *Xerarionta areolata*, but is almost certainly a beach drift shell, not an actual inhabitant of Baja California.

Polygyra behri is the type species of the monotypic subgenus *Monophysis* Pilsbry, 1956. Pilsbry (1956) distinguished *Monophysis* from the subgenus *Erymodon*, proposed in the same paper, solely by the absence of an upward collateral extension of the outer lip denticle. In a system as labile as apertural dentition in the Polygyridae, this character is probably of no more than species-level significance; we regard *Monophysis* as a synonym of *Erymodon*.

Family THYSANOPHORIDAE

Genus *Thysanophora* Strebel and Pfeffer, 1880

Thysanophora hornii (Gabb, 1866)

(Fig. 32)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Saltillo Pass, elev. 3,200 ft [975 m], G. Eisen, 1893 (Cooper 1894). Bahía Agua Verde, N side of canyon back of landing, CAS 1921 Exped. (Hanna 1923; CAS); G D. Hanna, 1953 ORCA Exped. (CAS). Gulf slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta to Guajadame, ca. 1.5 mi [2.4 km] from Pie de la Cueta, C. C. Christensen, 23 Oct. 1972 (CCC); and 1 mi [1.6 km] from Pie de la Cueta, elev. ca. 2,100 ft [640 m], C. C. Christensen, 22 Oct. 1972 (CCC). San José Comondú, elev. 1,500 ft [460 m], W. B. Miller, 20 Dec. 1970 (Bequaert and Miller 1973; WBM). San Javier, in rockslide across stream from mission, elev. 1,300 ft [400 m], C. C. Christensen, 25 Oct. 1972 (CCC). Along main highway from Loreto to Villa Insurgentes at km 69 N of Villa Insurgentes, at crest of Sierra de la Giganta among rocks, C. C. Christensen, W. B. Miller, 5 Dec. 1974 (CCC). Road between El Obispo and Rancho Tinajitas, I. L. Wiggins, 20 Nov. 1959 (CAS). Juncalito, in rockslide, C. C. Christensen, S. Kessler, 20 July 1974 (CCC). Arroyo de los Pozos, 12.9 mi [20.6 km] E of La Paz on road to Las Cruces, A. G. Smith, CAS 1958–1959 Exped. (CAS). 1.3 mi [2.0 km] N of El Triunfo, A. G. Smith, CAS 1958–1959 Exped. (CAS). Arroyo ca. 15 mi [24 km] S of La Paz, in drift, A. G. Smith, CAS 1959 Exped. (CAS). Km 5000.2 S of San Antonio, in leafmold, A. G. Smith, CAS 1958–1959 Exped. (CAS). In granite rocks in deep ravine 1.4 mi [2.2 km] from highway on road to microwave station above San Bartolo, C. C. Christensen, W. B. Miller, 8 Dec. 1974 (CCC). Arroyo by road to Valle Perdido, 2.0 mi [3.2 km] from Bajada del Molino, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28, 29 Dec. 1973 (CCC). Along trail from La Burrera to La Laguna, Sierra de la Victoria, elev. 4,500–6,000 ft [1,400–1,800 m], C. C. Christensen, 1 Jan. 1974 (CCC). Boca de la Sierra, A. G. Smith, CAS 1958–1959 Exped. (CAS). Boca de la Sierra, 1–1.5 mi [1.6–2.4 km] upstream of village, among granite rocks

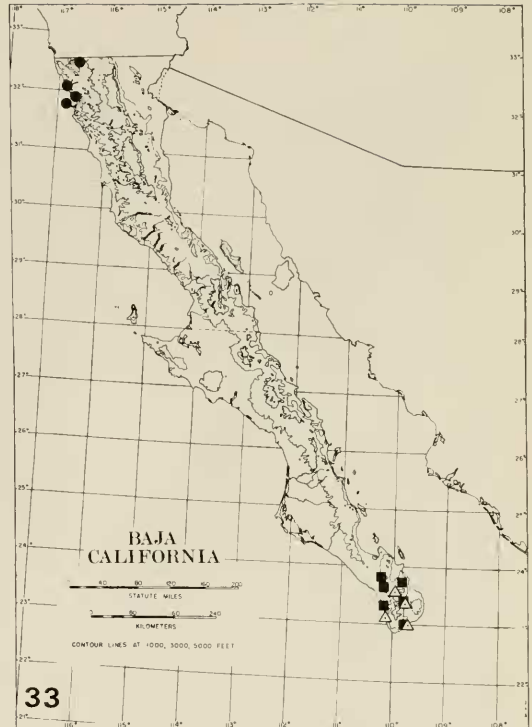


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FIGURE 32. Distribution in Baja California of *Thysanophora hornii*.

near stream, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Boca de la Sierra, ca. 1 mi [1.6 km] above village, from litter, C. C. Christensen, W. B. Miller, 7 Dec. 1974 (CCC). Arroyo Candelaria, 2.3 mi [3.7 km] inland from Migriño, elev. 20 ft [60 m], C. C. Christensen, J. A. Christensen, 21 Dec. 1975 (CCC). 13.5 mi [21.6 km] NE of Santa Catarina on road to Los Frailes, elev. 1,200 ft [360 m], C. C. Christensen, J. A. Christensen, 23 Dec. 1975 (CCC). Sierra Cacachila, 9.8 mi [15.7 km] E of La Paz—Cabo San Lucas Highway, elev. 1,400 ft [430 m], C. C. Christensen, J. A. Christensen, 18 Dec. 1975. 0.2 mi [0.3 km] SSE of San José del Cabo on road to La Playa, stream drift, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS). 5.4 mi [8.6 km] ENE of Cabo San Lucas on road to San José del Cabo, A. G. Smith, CAS 1958–1959 Exped. (CAS). 5.3 mi [8.5 km] NW of Todos Santos along road to La Pastora, A. G. Smith, CAS 1958–1959 Exped. (CAS). Bahía San Pedrito, 3.9 mi [6.2 km] SE of Todos Santos, A. G. Smith, CAS 1958–1959 Exped. (CAS). Along road between Cabo San Lucas and Todos Santos, 2.2 mi [3.5 km] N of El Saucito, in granite outcrops W of road, elev. ca. 1,500 ft [460 m] C. C. Christensen, J. A. Christensen, W. B. Miller, 22 Dec. 1973; C. C. Christensen, 9 Aug. 1974. N slope of highest hill at Cabo San Lucas, elev. ca. 250 ft [80 m], C. C. Christensen, J. A. Christensen, W. B. Miller, 24 Dec. 1973 (CCC). Isla Carmen, CAS 1921 Exped. (Hanna 1923; CAS). Isla Monserrate, CAS 1921 Exped. (Hanna 1923; CAS). Isla Espíritu Santo, C. C. Christensen, 5 Aug. 1974 (CCC).

This species, widespread in the region from Mulegé south and on several of the Gulf islands,



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FIGURE 33. Distribution of *Pseudosubulina eiseniana* (open triangles), *Pseudosubulina tastensis* (squares), and *Glyptostoma newberryanum depressum* (circles).

also occurs in Arizona, New Mexico, Texas, and the Mexican states of Sonora, Chihuahua, Sinaloa, Jalisco, Nuevo León, Tamaulipas, and San Luis Potosí (Bequaert and Miller 1973).

Superfamily OLEACINOIDEA

Family OLEACINIDAE

Genus *Pseudosubulina* Strebel and Pfeffer, 1882

Pseudosubulina eiseniana (Cooper, 1893)

(Fig. 33)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Cape Region, under stones (TL), G. Eisen, 1892 (Cooper 1893). Boca de la Sierra, near Miraflores, A. G. Smith, CAS 1958–1959 Exped. (CAS). In stream drift, 0.2 mi [0.3 km] SSE of San José del Cabo, on road to La Playa, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS). La Laguna, among rocks along stream near cabin, elev. ca. 6,500 ft [1,980 m], C. C. Christensen, W. B. Miller, 31 Dec. 1973 (WBM). Along trail from La Burrera to La Laguna, in rockslide, elev. ca. 3,000 ft [900 m], W. B. Miller, 2 Jan. 1974 (WBM). Along Todos Santos—Cabo San Lucas road 2.2 mi [3.5 km] N of El Saucito (and ca. 14 mi N of Cabo San Lucas), among granite rocks at crest of hill, elev. ca. 1,200 ft [360 m], W. B. Miller, W. N. Miller, 23 Dec. 1970 (WBM).

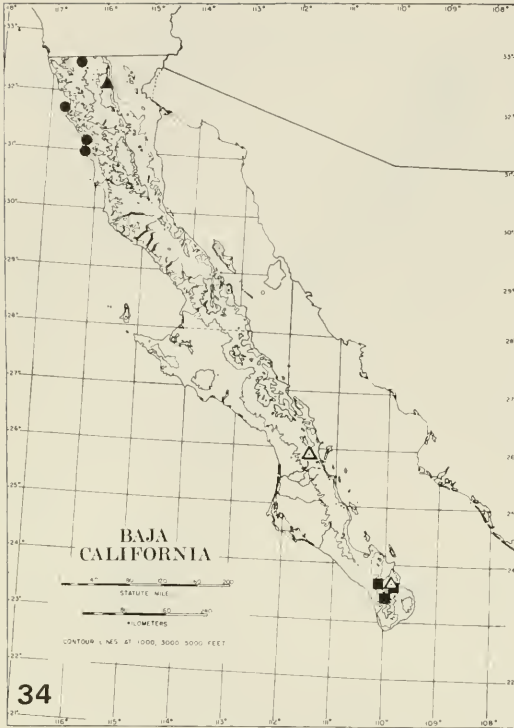


FIGURE 34. Distribution of *Radiocentrum discus* (squares), *Radiocentrum exorbitans* (open triangles), *Helminthoglypta tuciculata* (circles), and *Helminthoglypta* sp. (solid triangle).

Cooper (1893) did not specify an exact type locality for *P. eiseniana*, noting only that Eisen found 14 specimens living under stones; reference throughout the Cooper paper is to material collected by the CAS expedition of March to May 1892.

Pseudosubulina tastensis (Cooper, 1894)

(Fig. 33)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Saltito Pass, just N of Sierra El Taste, elev. 3,200 ft [975 m] (TL), G. Eisen, 1893 (Cooper 1894). 1.3 mi [2.1 km] N of El Triunfo, A. G. Smith, CAS 1958–1959 Exped. (CAS). 5.3 mi [8.5 km] NW of Todos Santos, on road to La Pastora, A. G. Smith, CAS 1958–1959 Exped. (CAS). Boca de la Sierra, near Miraflores, A. G. Smith, CAS 1958–1959 Exped. (CAS). 0.2 mi [0.3 km] SSE of San José del Cabo, in stream drift, A. G. Smith, A. E. Leviton, CAS 1958–1959 Exped. (CAS). About 0.6 mi [1.0 km] SE of San Bartolo, along S side of arroyo, among granite boulders, W. B. Miller, 28 Dec. 1970 (WBM). Along road from Valle Perdido to ranch at Bajada del Molino, in rockslides on N-facing slope of arroyo S of road, elev. ca. 1,400 ft [430 m], C. C. Christensen, W. B. Miller, 28, 29 Dec. 1973 (CCC).

Superfamily CAMAENOIDEA

Family MEGOMPHICIDAE

Genus *Glyptostoma* Bland and Binney, 1873

Glyptostoma newberryanum depressum Bryant, 1902

(Fig. 33)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: “Found alive under dead plants of a species of *Cotyledon* in a canyon near Todos Santos bay,” C. R. Orcutt (Orcutt 1886, as *G. newberryanum*). Bluffs N of Ensenada de Todos Santos (TL), F. W. Bryant (Bryant 1902). El Tigre canyon, ca. 9 mi [14 km] N of Ensenada, along highway to Tijuana, W. B. Miller, 15 Feb. 1959 (WBM). Slope of bluff near mouth of Río El Tigre, 6 mi [10 km] N of Ensenada, E. P. Chace, E. M. Chace, 1 Feb. 1939 (SBMNH). Puente San Miguel, Río El Tigre, C. C. Christensen, 9 Nov. 1973 (CCC). Rock slide near S end of highway bridge, El Tigre canyon, S. S. Berry, H. L. Fletcher, 26 Jan. 1948 (SBMNH). Under stones near the San Diego road 2 mi. [3.2 km] N of Ensenada, L. G. Ingles, 15 Dec. 1927 (Berry 1928, as *G. newberryanum*; SBMNH). Isla Todos Santos, H. N. Lowe, 1912 (Lowe 1913); H. Hemphill (Hemphill 1881; CAS). Nachoguerro Valley [Cañada Macho Güero] (Dall 1897, as *G. newberryanum*).

Glyptostoma newberryanum depressum is a weakly characterized subspecies of the otherwise southern Californian species *G. newberryanum* (Binney, 1858). Berry (1928) doubted the validity of the subspecies, but Pilsbry (1939) retained it pending an anatomical investigation.

Family OREOHELICIDAE

Genus *Radiocentrum* Pilsbry, 1905

Radiocentrum discus Christensen and Miller, 1976

(Fig. 34)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Along road from Valle Perdido to ranch at Bajada del Molino, 3.2 km by road from Bajada del Molino, in rockslides on N-facing slope of large arroyo S of the road, elev. ca. 425 m (TL), C. C. Christensen, W. B. Miller, 28, 29 Dec. 1973 (Christensen and Miller 1976a; CAS, SBMNH). 1 km SE of San Bartolo, on N-facing slope of arroyo, among granite boulders, elev. ca. 250 m, W. B. Miller, 28 Dec. 1970, 19 Dec. 1973 (WBM), 5 km E of La Burrera, in large rockslide along trail from La Burrera to La Laguna, elev. ca. 1,000 m, W. B. Miller, 2 Jan. 1974 (WBM).

Radiocentrum exorbitans (Miller, 1973)

(Fig. 34)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Sierra de la Giganta at Misión San Javier, in lava rockslides immediately S of the mission, approximately 32 km by road SW of Loreto, elev. 400–450 m (TL), W. B. Miller, Oct. 1971 (Miller 1973; CAS). 1 km SE of San Bartolo, W. B. Miller, 28 Dec. 1970 (Miller 1973; WBM).

Superfamily HELICOIDEA
 Family HELMINTHOGLYPTIDAE
 Genus *Helminthoglypta* Ancey, 1887
 Subgenus *Helminthoglypta* sensu stricto

Helminthoglypta (Helminthoglypta) tudiculata
 (Binney, 1843)

(Fig. 34)

SYNONYM.—*Helix tudiculata* var. *binneyi* Hemphill, 1890.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: "Among the hills of Lower California near the United States boundary," C. R. Orcutt (Orcutt 1886). Near Bahía de Todos Santos (Hemphill 1881). Nachogüero Valley [Cañada Macho Güero] (Dall 1897). Punta Banda, M. W. Williams, K. W. Kenyon, 1946 (SBMNH). Near the narrowed part of Punta Banda, L. G. Ingles, 17 Dec. 1927 (Berry 1928; SBMNH). San Antonio Canyon, about 5 mi [8 km] N of Johnson Ranch, under stones in rockslide on moist E-facing cliff, L. G. Ingles, 18 Dec. 1927 (Berry 1928; SBMNH). Johnson Ranch, S. Peyton (CAS).

Helminthoglypta tudiculata extends north in southern California to Los Angeles and San Bernardino counties. Berry (1928) found Baja California specimens to be "fairly typical" in morphology and not distinguishable taxonomically from specimens from San Diego, the type locality.

Subgenus *Charodotes* Pilsbry, 1939

Helminthoglypta (Charodotes) hannai hannai
 Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe: W. E. Bryant (Cooper 1892a, as *Helix traskii* var. *carpenteri*); A. W. Anthony, 1896 (Dall 1900, as *Epiphragmophora* sp. indet.); G. Willett, 8 Apr. 1938 (CAS): Pine Ridge, elev. 3,000 ft [900 m] (TL), under stones beneath moisture-laden pine trees, G. D. Hanna, July 1922, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH).

Helminthoglypta hannai hannai has a relatively flat, widely umbilicate shell with smooth, olive-green periostracum; it is not closely related to nearby mainland *H. traskii* subsp. populations.

Helminthoglypta (Charodotes) hannai didon
 Pilsbry, 1927

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe, Northeast Anchorage (TL), and 3 mi [4.8 km] S of Northeast Anchorage, G. D. Hanna, July 1922, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH).

The two specimens comprising the type material of *H. h. hannai* (CAS 2560, 2561) are thin,

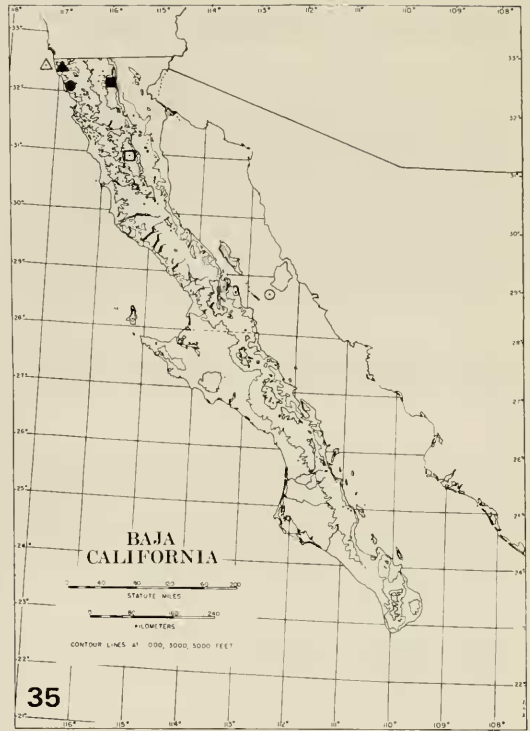


FIGURE 35. Distribution of *Helminthoglypta coelata* (solid triangle), *Helminthoglypta misiona* (solid circle), *Helminthoglypta reederi* (open square), *Helminthoglypta traskii coronadoensis* (open triangle), *Eremarionta indioensis* (solid square), and *Eremarionta rowelli bechteli* (open circle).

fragile, fresh adult shells; they show evidence of incipient callus nodules on the parietal wall. The type material of *H. h. didon* (four specimens, CAS 2562, 2563–2565) are old, possibly fossil, thicker, worn shells with well-developed callus nodules. We suspect that *H. h. didon* may not be truly a subspecies but consists, rather, of gerontic individuals of *H. hannai*, perhaps selectively preserved by post-mortem processes.

Helminthoglypta (Charodotes) coelata (Bartsch, 1916)

(Fig. 35)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: 7 mi [11 km] S of Tijuana, E. P. and E. M. Chace, Feb. 1939 (CAS).

This species also occurs in California along the coast of San Diego County as far north as La Jolla and Soledad Mountain (CAS).

Helminthoglypta (Charodotes) misiona Chace, 1937

(Fig. 35)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: La Misión Valley, in rockslide near the San Diego–Ensenada highway, about 40 mi [64 km] S of Tijuana (TL), E. P. and E. M. Chace, G. Willett, 1937 (Chace 1937; LACM; CAS). La Misión Valley, along Tijuana–Ensenada highway, in rockslide on S side of valley, seaward side of bridge, W. B. Miller, 14 Feb. 1959 (WBM). El Progreso, Sandoval Ranch area (ca. 30 mi [48 km] S of Tijuana), E. P. Chace, 8 Dec. 1957 (CAS). 16 mi [26 km] N of Ensenada, G. Willett (CAS).

Helminthoglypta (Charodotes) reederi Miller, 1981

(Fig. 35)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Sierra San Pedro Mártir, in rock outcrops in a small canyon which crosses the road to the astronomical observatory, at a distance of about 2.5 road km below the observatory housing area, elev. ca. 2,575 m (TL), W. B. Miller, R. L. Reeder, C. C. Christensen, 3 Nov. 1973 (Miller 1981a; CAS, RLR, USNM, WBM).

Helminthoglypta (Charodotes) traskii corona-
doensis (Bartsch, 1916)

(Fig. 35)

SYNONYM.—*Epiphragmophora traskii chryso-derma* Berry, 1920.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Islas Los Coronados (TL), H. Hemphill (Bartsch 1916; USNM; CAS); G. W. Dunn (Cooper 1892a, as *Helix traskii* var. *carpenteri*). South Coronado Island, among loose talus on higher portion of southern end, G. Willett, 13 Dec. 1918 (Berry 1920; TL of *Epiphragmophora traskii chryso-derma*; CAS; SBMNH, ex S. S. Berry).

The form *chryso-derma* was based upon bandless, xanthic specimens, which are evidently numerous in certain colonies.

Helminthoglypta (Charodotes) traskii subsp.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Near mouth of Santo Tomás River, H. Hemphill (Hemphill 1881; CAS). Santo Tomás Canyon, 4.1 mi [6.6 km] from Transpeninsular Highway, along road to harbor, under rocks on wooded slope, W. B. Miller, 27 Jan. 1962 (WBM).

The shells found “as far south as Santo Tomás,” reported as *Arionta traskii* by Orcutt (1886: 62) represent an unidentified subspecies.

Subgenus uncertain

Helminthoglypta sp.

(Fig. 34)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Ca. 35 mi [56 km] SE of Rumorosa, Sierra Juárez, under heavy granite

rocks in *Pinus parryana* forest, E. C. Jaeger, R. S. Phair, 23 June 1958 (SBMNH).

This undescribed species is known from shells only. Its description is postponed until more material, including soft parts, is available.

Genus *Micrarionta* Ancey, 1880**Micrarionta guadalupiana** (Pilsbry and Vanatta, 1898)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Guadalupe (TL): E. Palmer, 1875 (Binney 1879, as *Arionta facta*); G. W. Dunn (Cooper 1887, as *Helix facta*); A. W. Anthony, 1896; R. E. Snodgrass, E. Heller, 1899 (Dall 1900); Northeast Anchorage and 3 mi [4.8 km] to the south; Pine Ridge, NW end of island, elev. ca. 3,000 ft [900 m]; West Anchorage, G. E. Lindsay, 30 Jan. 1950 (SBMNH); near lobster camp, E side of island, E. P. Chace, 18 Dec. 1957 (SBMNH); E side of island 2 mi [3.2 km] N of the South Point, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS, SBMNH); S end of island, M. W. Williams, Dec. 1946 (SBMNH). Outer islet, 2 mi [3.2 km] off S end of Isla Guadalupe, G. E. Lindsay, 27 Jan. 1950 (SBMNH).

This species dates from the publication of a figure of its reproductive system by Pilsbry and Vanatta (1898), rather than from the description of the shell by Dall (1900).

Pilsbry (1927) noted that in a specimen sent to him by Dall, he found the dart sac absent; in other specimens from near Northeast Anchorage a well-developed dart sac was present. Although he stated, “I incline to the theory that the organs of the paratype . . . which I examined are not mature or were abnormal” (Pilsbry 1927:165), we do not rule out the possibility that two species may actually exist, one with dart apparatus and the other without. The species *Micrarionta opuntia* Roth, 1975, from San Nicolas Island, California, lacks a dart sac.

Genus *Plesarionta* Pilsbry, 1939**Plesarionta orcutti** (Dall, 1900)

(Fig. 36)

SYNONYMS.—*Epiphragmophora traskii* var. *tularensis* ‘Hemphill,’ Pilsbry, 1895 (nomen nudum) (non *Arionta tudiculata* var. *tularensis* Hemphill in Binney, 1892). *Epiphragmophora traskii tularica* Bartsch, 1916.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: “Rosario mesas, in northern Lower California” (TL), C. R. Orcutt, May 1886 (Dall 1900; SBMNH). Mesa about 1.5 mi [2.4 km] N of El Rosario, under *Agave shawii*, S. S. Berry, C. L. Hubbs, 13 Apr. 1954 (SBMNH). El Rosario, elev. 100 ft [30 m], S. C. Williams, 1969 (CAS). Rosario Mesa, W. B. Miller, C. C. Christensen, 1973 (WBM).

This species differs from *Plesarionta stearnsiana* in color pattern and in the presence of in-

cised spiral lines in the shell; there are no discernible differences in anatomy. *Plesarionta orcutti* is sympatric with *P. stearnsiana* on Rosario Mesa. We do not exclude the possibility that it is only a local conspecific variant of *P. stearnsiana*. The misallocation of the type material of *Epiphragmophora traskii tularica* to "Frasers Mills, Tulare County, California," was discussed by Roth (1982).

The agave habitat at the type locality of *P. orcutti* has been destroyed by conversion of the land to agriculture.

Plesarionta stearnsiana (Gabb, 1868)

(Fig. 36)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Islas Los Coronados, F. E. Blaisdell, 1881 (CAS); H. Hemphill (Hemphill 1881, 1901; CAS); E. C. Johnston, R. A. Coleman, USFC ALBATROSS, 22 May 1916 (CAS). North Coronado Island, W. G. Craig, L. H. Miller, 6 May 1928 (SBMNH); near boat landing, B. W. Evermann (CAS); rockslides on E slope of island, M. W. Williams, K. W. Kenyon, 2 Mar. 1946 (SBMNH). Middle Coronado Island, K. W. Kenyon, 26 July 1946 (SBMNH). South Coronado Island, A. G. Smith, 21 July 1912, Mar 1919 (Berry 1928; CAS, SBMNH); G. Willett, 13 Dec. 1918 (Berry 1928; SBMNH). Point S of Mesquite Point, near El Descanso, in clumps of *Agave shawii*, S. S. Berry, H. L. Fletcher, 27 Jan. 1948 (SBMNH). Rockslide near San Diego-Ensenada highway, La Mision Valley, ca. 40 mi. Arroyo 9 mi. [64 km] S of Tijuana, E. P. and E. M. Chace, G. Willett, 1937 (Chace 1937). Slope of bluff near mouth of Río El Tigre, E. P. Chace, E. M. Chace, 1 Feb. 1939 (SBMNH). Rockslides near S end of highway bridge, El Tigre, S. S. Berry, H. L. Fletcher, 26 Jan. 1948 (SBMNH). Rockslides on S canyon wall below Misión San Miguel, S. S. Berry, H. L. Fletcher, 27 Jan. 1948 (SBMNH). Canyon 5 mi [8 km] inland from Ensenada, on and under *Opuntia*, V. W. Owen, 1 July 1923 (CAS). Punta Banda, H. N. Lowe, 1912 (CAS); S. S. Berry, H. L. Fletcher, 25 Jan. 1948 (SBMNH); L. G. Ingles, 17 Dec. 1927 (SBMNH). Arbolitos, SW side of Punta Banda, S. S. Berry, 10 Apr. 1954 (SBMNH). Islas de Todos Santos, H. Hemphill (Hemphill 1881), H. N. Lowe, 1912 (Lowe 1913); E. C. Johnston, 12 Feb. 1917 (CAS); J. R. Slevin, May 1923 (CAS); G. Willett (CAS); I. L. Wiggins, J. H. Thomas, 4 Feb. 1949 (SBMNH); Puritan-AMNH Exped., 1957 (Jacobson 1958). "Found under stumps of Maguey from Sto. Tomas to a little beyond Rosario" (TL) (Gabb 1868, Pilsbry 1939, Coan and Bogan 1988; ANSP). Near mouth of San [Santo] Tomás River (Hemphill 1881; CAS). Santo Tomás, E. C. Johnston, 13 Feb. 1917 (CAS). Punta China, C. L. Hubbs, 18 Sep. 1948 (SBMNH). Punta Cabras, C. L. Hubbs, 15 Aug. 1948 (SBMNH). Near San Isidro, C. R. Orcutt, June 1919 (SBMNH). Coast just N of mouth of Río San Telmo, C. L. Hubbs, 6 Sep. 1948 (SBMNH). San Telmo Mesa, under dead agave, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 10 Oct. 1946 (SBMNH). 5 mi [8 km] S of Colonel, in dead agave stalk, P. H. Arnaud, 24 Apr. 1963 (CAS). 8 mi [13 km] E of San Telmo de Arriba, elev. 500 ft [150 m], S. C. Williams, V. F. Lee, 13 July 1969 (CAS). Vicinity of Colonel, San Telmo, and Colonia Guerrero (Miller 1981a). 10 mi [16 km] S of Camalú, G. Wiggins, 21 June 1971 (CAS). Isla San Martín, A. W. Anthony, 1896 (Dall 1900); F. Baker (1902); H. N. Lowe, 1912

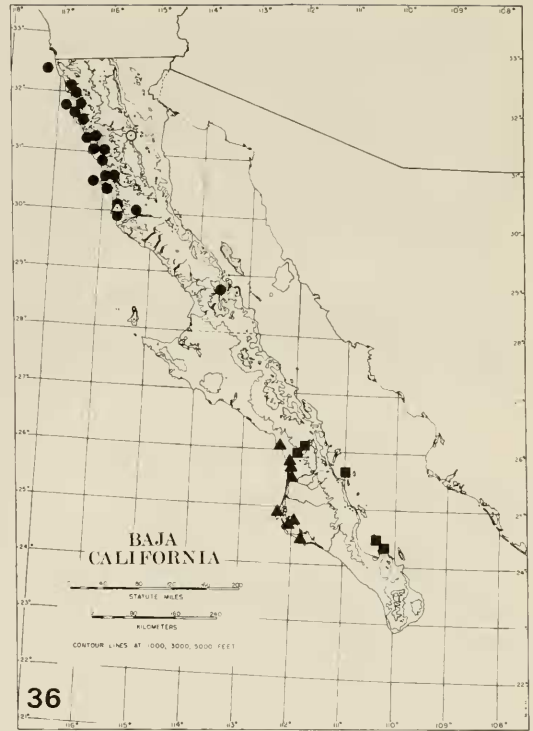


FIGURE 36. Distribution of *Plesarionta orcutti* (open triangle); *Plesarionta stearnsiana* (solid circles); *Xerarionta areolata*, living (solid triangles); *Xerarionta areolata*, fossil (squares); and *Eremarionta* sp. (open circle).

(Lowe 1913); E. C. Johnston, 1916, 1917 (CAS); G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); Templeton Crocker Exped. of CAS, 19 Aug. 1932 (CAS); Hassler Cove, M. W. Williams, K. W. Kenyon, 3 Apr. 1946 (SBMNH); volcanic peaks, and rockslide at elev. 100 ft [30 m], SW side of island, M. W. Williams, K. W. Kenyon, 7 Apr. 1946. Numerous localities from California border to W shore of Bahía San Quintín, H. Hemphill (1901); G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); H. N. Lowe, 1912 (Lowe 1913); L. G. Ingles, Dec. 1927 (Berry 1928; SBMNH); C. R. Orcutt, 1 June 1919 (Berry 1928); I. L. Wiggins, H. M. Hill, 23 Oct. 1946 (SBMNH); S. S. Berry, G. Brandt, 23 Mar. 1949 (SBMNH); K. B. Macdonald (1969, as *Micrarionta* sp.; CAS). Canyon on N side of Santa Maria valley near San Simon, ca. 7–8 mi [11–13 km] from coast, E. P. Chace, 11 Sep. 1955 (SBMNH). "Mt. Ceniza," Bahía San Quintín, E. C. Johnston, 2 Mar. 1917 (CAS). 5 mi [8 km] S of Rancho El Socorro turnoff from main Baja California highway, A. G. Smith, 27 Mar. 1961 (CAS). 9 mi [14 km] N of El Rosario, ca. 1.5 mi [2.4 km] inland, I. L. Wiggins, 14 Oct. 1959 (CAS). Mesa near Rosario, C. R. Orcutt, 1885 (Orcutt 1886; SBMNH). 1.5 mi [2.4 km] E of Meling Ranch, elev. 2,450 ft [750 m], C. C. Christensen, W. B. Miller, 4 Nov. 1973 (CCC, WBM). Rosario Mesa, S. S. Berry, C. L. Hubbs, 13 Apr. 1954 (SBMNH); I. L. Wiggins, A. M. Vollmer, H. M. Hill, 24 Oct. 1946 (SBMNH); W. B. Miller, C. C. Christensen, 1973 (WBM). Coastal terrace, S side of Arroyo del Rosario, S. S. Berry, C. L. Hubbs, 12 Apr. 1954 (SBMNH). El Rosario,

elev. 100 ft [30 m], S. C. Williams, 6 Apr. 1969 (CAS). 1 mi [1.6 km] E of El Rosario, elev. 100 ft [30 m], S. C. Williams, 7 Apr. 1969 (CAS). 10 mi [16 km] S of El Rosario, I. L. Wiggins, 20 June 1971 (CAS). 12 mi [19 km] SE of El Rosario, around old agaves, I. L. Wiggins, 14 Oct. 1959 (CAS). 8 mi [13 km] NW of El Progreso, E. S. Ross, D. Q. Cavagnaro, 17 Apr. 1965 (CAS). [14.4 km] E of Millers Landing, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). La Zonja, Sierra San Pedro Mártir, J. P. Figg-Hoblyn, 16 June 1953 (CAS). Cerro de la Mina de San Juan, Sierra La Libertad, W. B. Miller, 1981 (WBM).

In California, *Plesarionta stearnsiana* occurs in southwestern San Diego County as far north as the vicinity of La Jolla (Berry 1928, Pilsbry 1939).

Genus *Xerarionta* Pilsbry, 1913

Xerarionta areolata (Pfeiffer, 1845)

(Fig. 36)

SYNONYMS.—*Helix areolata* var. *albida* Hemphill, 1890 (nomen nudum). *Helix areolata* var. *exanimata* Cooper, 1892. *Micrarionta areolata* var. *arida* Pilsbry, 1913. *Micrarionta areolata* var. *scammoni* Pilsbry, 1913. *Micrarionta areolata* var. *aspera* Pilsbry, 1913.

DISTRIBUTION.—BAJA CALIFORNIA SUR: Bahía Santa María, J. P. Figg-Hoblyn, 21 May 1952 (SBMNH); NE shore, T. Craig, 25 Feb. 1928 (SBMNH). Hills near abandoned Rancho Amargosa, central Isla Santa Margarita, J. T. Smith, 18 Mar. 1985 (SBMNH). Isla Margarita, southern division, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS). E shore, Bahía Almejas, I. L. Wiggins, H. M. Hill, 22 Nov. 1946 (SBMNH). Sandy rolling hills 7 mi [11 km] SE of Estero Salina, Bahía, Almejas, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 2 Nov. 1946 (SBMNH). 2.9 mi [4.6 km] N of San Juanico on W side of road to Candeje, J. T. Smith, 22 Mar. 1984, 1985 (SBMNH). Bahía San Juanico, A. S. Loukashkin, 14 Aug. 1961 (CAS). 16 mi [26 km] S of San Juanico, I. L. Wiggins, CAS 1958–1959 Exped. (CAS). 10 mi [16 km] N of Pozo Grande, E. S. Ross, B. Hammerly, G. E. Bohart, 24 Oct. 1941 (CAS). 4 mi [6.4 km] N of Pozo Grande, I. L. Wiggins, CAS 1958–1959 Exped. (CAS). Magdalena Plain, 25°50'N, 112°00'W, H. E. Gates, 10 Feb. 1931 (SBMNH). 11 mi [18 km] S of Pozo Grande, I. L. Wiggins, H. M. Hill, 29 Nov. 1946 (SBMNH). San Jorge, G. E. Lindsay, 5 Aug. 1951 (SBMNH). 10 mi [16 km] N of Santo Domingo, I. L. Wiggins, H. M. Hill, 20 Nov. 1946 (SBMNH). 5 mi [8 km] N of Santo Domingo, E. S. Ross, B. Hammerly, G. E. Bohart, 23 Oct. 1941 (CAS); I. L. Wiggins, H. M. Hill, 21 Nov. 1946 (SBMNH). San [Santo] Domingo Ranch, sandy mesa 5 mi [8 km] from coast, I. L. Wiggins, H. M. Hill, 19 Nov. 1946 (SBMNH). Bahía Magdalena (TL, designated by Pilsbry 1913:391); R. B. Hinds, 1839; W. M. Gabb, 1867; R. C. Macgregor (Pilsbry 1913); W. J. Fisher, 1876 (Stearns 1894); W. Newcomb (Dall 1900); C. R. Orcutt, Mar. 1917, 1919 (SBMNH); ocean beach, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); Man-of-War Cove, R. V. Moran (SBMNH). Isla Magdalena, C. R. Orcutt, Mar. 1917 (Orcutt 1918; SBMNH); G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); H. E. Gates, 15–16 Feb. 1931 (SBMNH); H. N. Lowe, 1931 (CAS); N of village, Puritan-AMNH Exped., 1957 (Jacobson 1958). Salada, near Bahía Magdalena (Gabb 1869). Sand hills,

Médano Amarillo, H. E. Gates, 27 Mar. 1932 (SBMNH). Médano Amarillo, J. H. Thomas, 21 May 1959 (CAS). N end of Cabo San Lázaro, Isla Magdalena, J. T. Smith, 1985 (SBMNH). Punta Belcher, H. N. Lowe, 1931 (Lowe 1933; CAS).

FOSSIL RECORDS.—San José Comondú, and lower arroyo 12 mi [19 km] SW of San Miguel Comondú, R. J. Drake, July 1953 (CAS). N end of Cabo San Lázaro, in fluvial-beach-terrace deposit, J. T. Smith, 1985 (SBMNH). Isla Espíritu Santo, W. E. Bryant, 1892 (Cooper 1892b; TL of *Helix areolata* var. *exanimata*; USNM; CAS); desert floor, SE end of island, M. W. Williams, 18 Apr. 1937 (SBMNH). Punta Coyote, N of La Paz, in a post-Pleistocene raised beach, L. B. Mousley, 17 Dec. 1952 (SBMNH); A. G. Smith, CAS 1958–1959 Exped. (CAS). NE end of Isla Monserrate, E. P. Van Duzee, CAS 1921 Exped. (Hanna 1923; CAS).

According to Pilsbry (1913), this and *Xerarionta levis* were collected in Baja California by Hinds during the voyage of HMS SULPHUR; he discussed earlier errors concerning the type locality. The varieties *arida*, *scammoni*, and *aspera* (all, Pilsbry 1913) are intrapopulation variants, of less than subspecific rank.

Specimens from Isla Espíritu Santo, Isla Monserrate, and Punta Coyote on the peninsula immediately south of Isla Espíritu Santo, were formerly referred to *Micrarionta exanimata* (Cooper) (e.g., by Hanna 1923). They are not distinguishable from *X. areolata*. The species apparently is extinct at these localities. One lot (CAS 032530) from the W. J. Raymond collection with data “Espíritu Santo I/Near La Paz/Cal. Acad. Sci. 1892” contains two fossil shells along with four fresh shells probably mixed in from another source. Coan (1982:163) regarded the fossil shells of this lot as syntypes of *Helix areolata* var. *exanimata*.

The southern limit of living *X. areolata* is unknown; no field work has been done along the coast between Bahía Magdalena and the vicinity of Todos Santos.

Xerarionta levis levis (Pfeiffer, 1845)

(Fig. 37)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Vicinity of Colonel, San Telmo, and Colonia Guerrero (Miller 1981a). Ocean bluff back of Hamilton Ranch, C. L. Cass, 1928 (SBMNH). Sand dunes 6–7 mi [10–11 km] NW of San Quintín, I. L. Wiggins, 8 May 1948 (SBMNH). “Mt. Ceniza,” Bahía San Quintín, E. C. Johnston (CAS). Volcanic hills W of Bahía San Quintín, C. C. Christensen, J. A. Christensen, 28 Dec. 1975 (CCC). Along shore road W of Kenton Hill, San Quintín Peninsula, S. S. Berry, 24 Mar. 1949 (SBMNH). Bahía San Quintín, on beach, USFC ALBATROSS, 21 Apr. 1916 (CAS). “Under the trunks and among the leaves of Agave Shawii, on a high mesa near Rosario.” C. R. Orcutt (Orcutt 1886; CAS, SBMNH); A. G. Smith, CAS 1958–1959 Exped. (CAS). Ro-

sario Mesa, F. M. Reed, 3 Feb. 1929 (SBMNH); H. E. Gates, 30 May 1930 (CAS); under *Penstemon*, M. W. Williams, K. W. Kenyon, 9 Apr. 1946 (SBMNH); S. S. Berry, C. L. Hubbs, 13 Apr. 1954 (SBMNH); W. B. Miller, C. C. Christensen, 1973 (WBM). On road between El Rosario and Punta Baja, M. W. Williams, K. W. Kenyon, 9 Apr. 1946 (SBMNH). Coastal terrace, N side of Punta Baja, S. S. Berry, C. L. Hubbs, 12 Apr. 1954 (SBMNH). Punta Baja, O. L. Bowen, 26 June 1962 (CAS). Isla San Geronimo, H. N. Lowe (Pilsbry 1913), fossil only. 6 mi [10 km] S of El Marmolito, A. G. Smith, 30 Mar. 1961 (CAS). Between Punta Prieta and Punta Rosarito, I. L. Wiggins, 18 Oct. 1959 (CAS). 12.5 mi [20.0 km] S of Punta Prieta, under dead agaves, I. L. Wiggins, H. M. Hill, 28 Oct. 1946 (SBMNH). 15 mi [24 km] S of Punta Prieta, I. L. Wiggins, H. M. Hill, 28 Oct. 1946 (SBMNH); S. C. Williams, K. B. Blair, 7 July 1973 (CAS). 35 mi [56 km] S of Punta Prieta, under agaves, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). NE of Santa Rosalillita, D. E. Breedlove, 21 Mar. 1984 (CAS). "Rosalia Bay" [Bahía Santa Rosalillita], A. W. Anthony, 1896 (Dall 1900). 7 mi [11 km] and 3 mi [4.8 km] NNW of Rosarito, A. G. Smith, Mar.–Apr. 1961 (CAS). Sandy hills N side of estero at mouth of Arroyo del Rosario, 17 Nov. 1967 (CAS). 2.5 mi [4.0 km] S of Rosalillita Beach, I. L. Wiggins, 1959 (CAS). 4 mi [6.4 km] NW of San Javier (N of Millers Landing), S. C. Williams, 15 Apr. 1969 (CAS). Between Rosalillita and Millers Landing, I. L. Wiggins, 18 Oct. 1959 (CAS). 5 mi [8 km] N of Millers Landing, H. E. Gates, 6 Apr. 1931 (SBMNH). Arroyo 9 mi [14 km] E of Millers Landing, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). Millers Landing, under dead *Echinocereus maritimus*, I. L. Wiggins, H. M. Hill, 29 Oct. 1946 (SBMNH). 2 mi [3.2 km] S of Millers Landing, I. L. Wiggins, 1959 (CAS). 8 mi [13 km] S of Millers Landing, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 29 Oct. 1946 (SBMNH). 5 mi [8 km] NW of Rancho Mezquital, granite boulder hill, A. G. Smith, 30 Mar. 1961 (CAS). 4 mi [6.4 km] N of Rancho Mezquital, E. S. Ross, B. Hammerly, G. E. Bohart, 29 Oct. 1941 (CAS); A. G. Smith et al., Mar. 1961 (Wiggins 1969). Mesa just S of Rancho Mezquital, under dead agaves, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 30 Oct. 1946 (SBMNH). Laguna Santo Domingo, C. R. Orcutt (CAS, SBMNH). Near Laguna Manuela, H. Hemphill (CAS, SBMNH). Puerto San José, and road to Puerto San José at elev. 250 m, I. L. Wiggins, 9 Feb. 1962 (CAS). 16 mi [26 km] N of Espina, E of Guerrero Negro, I. L. Wiggins, 19 Oct. 1959 (CAS). 5 km E of La Espina, A. G. Smith, A. E. Leviton, I. L. Wiggins, B. H. Banta, 30 Mar. 1961 (Wiggins 1969; CAS). Laguna Guerrero Negro, A. G. Smith, 4 Nov. 1959 (CAS). BAJA CALIFORNIA SUR: Desert flats 4.5 mi [7.2 km] E of Guerrero Negro, I. L. Wiggins, 1959 (CAS). 5 km E of Guerrero Negro, A. G. Smith, 30–31 Mar. 1961 (Wiggins 1969). 4.5 mi [7.2 km] E of El Solito, I. L. Wiggins, 1969 (CAS). Scammons Lagoon [Laguna Ojo de Liebre], W. M. Pierce (CAS); L. M. Huey, 22 May 1926 (SBMNH); G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); E. P. Chace, 16 July 1954 (SBMNH); Puritan-AMNH Exped., 1957 (Jacobson 1958). North side, Bahía Tortugas, G. D. Hanna, 12 Mar. 1953 (CAS). Cerro de la Banderilla, Sierra de Placeros, on road to Bahía Tortugas, D. E. Breedlove, 24 Mar. 1984 (CAS). Bahía San Roque, E. C. Johnston (CAS). Punta Asunción, J. P. Figg-Hoblyn, 28 Mar. 1952 (SBMNH). Isla Asunción, W. J. Fisher,

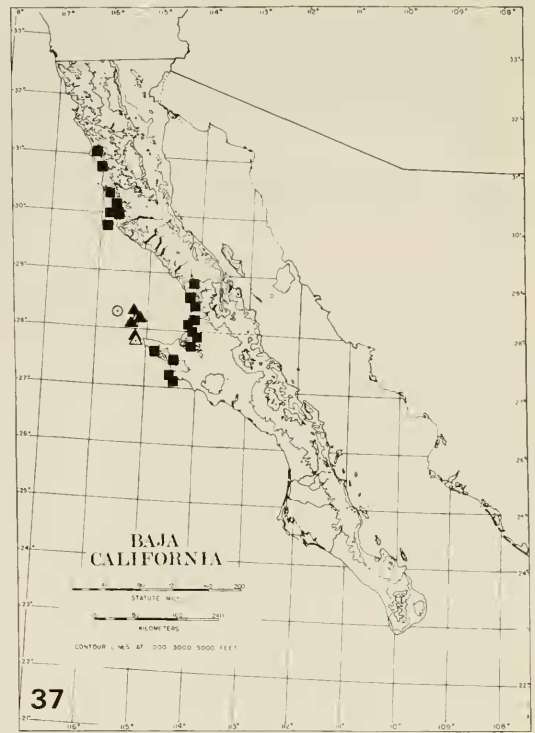


FIGURE 37. Distribution of *Xerarionta levis levis* (squares), *Xerarionta levis canescens* (solid triangles), *Xerarionta levis crassula* (open triangle), and *Xerarionta pandorae* (open circle).

1876 (Stearns 1894); G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

We can find no anatomical differences between specimens of *Xerarionta levis levis* on the mainland and *X. l. canescens* from Islas Cedros and Natividad. There are populations of *X. l. levis* that approach the size and shape of *X. l. canescens*. There is also a lot (CAS 26301) of *X. levis crassula* from Isla Natividad that appears to be fossil. It is our opinion that mainland populations are all *X. l. levis*, with large variations in shell size. We believe that *X. l. canescens* of Islas Cedros and Natividad and the peninsular *X. l. levis* evolved from a recent common ancestor and are only subspecifically distinct.

Baily (1942) reported a sinistral specimen of "*Micrarionta levis*" from salt flats south of Santo Domingo. The locality description is suggestive of Santo Domingo (del Pacífico) in Baja California Sur, within the range of *X. areolata*, and we suspect that the specimen was misidentified.

The apparent disjunction in the mainland range of this species (Fig. 37) is probably an artifact of

the inaccessibility of the coastal zone between El Rosario and Millers Landing. The southern limit is not well known, owing to the lack of field investigation in likely habitats south of Bahía San Roque.

Xerarionta levis canescens (Adams and Reeve, 1848)

(Fig. 37)

SYNONYMS.—*Arionta veitchii* 'Newcomb,' Tryon, 1866. *Helix areolata* var. *cedrosensis* Hemphill, 1890 (nomen nudum). *Epiphragmophora leucanthea* Dall, 1900. *Micrarionta levis globosa* Pilsbry, 1913.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Isla Cedros (TL): J. A. Veatch, 1859 (Stearns 1894; SBMNH); A. W. Anthony, 1896 (Dall 1900); H. Hemphill; H. N. Lowe, 1912 (Pilsbry 1913; ANSP, CAS); E. C. Johnston, 13 Jan. 1917 (CAS); F. Baker (1918); M. W. Williams, K. W. Kenyon, 1946 (SBMNH); K. E. Lucas, 17 Mar. 1973 (CAS); elev. 0–300 ft [0–90 m], Hubbs-Flynn "ZACA" Exped., 20 Aug. 1946 (SBMNH); Abalone Cove, N end of island, C. B. Perkins, Feb. 1932 (SBMNH); 1 mi [1.6 km] up canyon back of anchorage, NE end of island, M. W. Williams, 28 Feb. 1941 (SBMNH); NE landing, E. C. Johnston, 29 May 1916 (CAS); E side of island (Dall 1900; TL of *Epiphragmophora leucanthea*; USNM); NE of Cedros Village near spring, C. C. Christensen, W. B. Miller, 12 May 1975 (CCC, WBM); W side near Red Rocks; Bernstein's Spring at elev. 2,000 ft [600 m], on desert plants; N end near old mine; "Grand Canyon" near center of E side of island; Bernstein's Camp; and South Bay, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); abalone camp, L. G. Hertlein, 1932 (CAS); S end of island, A. E. Colburn, 15 Nov. 1926 (SBMNH); J. R. Slevin, 1940 (CAS); South Bay, and 1 mi [1.6 km] E and 4 mi [6.4 km] S of North Point, Puritan-AMNH Exped., 1957 (Jacobson 1958). BAJA CALIFORNIA SUR: Isla Natividad: A. W. Anthony, 1896 (Pilsbry 1913); M. W. Williams, K. W. Kenyon, 15 May 1946 (SBMNH); C. C. Christensen, W. B. Miller, 13 May 1975 (CCC, WBM); N side below first giant cactus, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS).

Pilsbry (1913) discussed the provenance of the type material of *Helix canescens*, originally stated to be from Africa. *Arionta veitchii* (emended to "*veitchii*" by later authors) is not consistently distinguishable from *X. l. canescens*, and we consider it to be a high-spired form that appears in various populations. Dall's (1900) *Epiphragmophora leucanthea* has been treated as an infrasubspecific form by Pilsbry (1927) and Jacobson (1958); we consider it to have no taxonomic standing. Likewise, we consider *Micrarionta levis globosa*, described from Isla Cedros, a synonym of *X. l. canescens*.

Xerarionta levis crassula (Dall, 1900)

(Fig. 37)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Isla Natividad (TL): A. W. Anthony, 1896 (Dall 1900; USNM); G. D. Hanna,

CAS 1922 Exped. (Pilsbry 1927; CAS); From soft sandstone near middle of E side of island, M. W. Williams, K. W. Kenyon, 16 May 1946 (SBMNH).

This name is applicable to fossil populations from Isla Natividad consisting of shells consistently smaller than modern snails inhabiting that island. Fossil shells from Isla San Gerónimo are similar to *X. l. crassula* in size and contour (Pilsbry 1913; CAS, SBMNH).

Xerarionta pandorae (Forbes, 1850)

(Fig. 37)

SYNONYMS.—*Helix damascenus* Gould, 1856. *Epiphragmophora pandorae bonitosensis* Pilsbry and Vanatta, 1898.

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Islas San Benito (TL), HMS HERALD and PANDORA, 1849 (Pilsbry 1913); A. W. Anthony, 1896 (Dall 1900); H. Hemphill (Pilsbry 1913; ANSP, SBMNH); H. N. Lowe, 1931 (Lowe 1933). Isla San Benito del Oeste: G. E. Lindsay, 5 Jan. 1950 (SBMNH); Puritan-AMNH 1957 Exped. (Jacobson 1958); R. C. Brusca, 6 Jan. 1954 (WBM); W. B. Miller, C. C. Christensen, 1975 (WBM); in rockslides on N side, NE point, and S side, G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); elev. 0–500 ft [0–150 m], near E end of island, Hubbs-Flynn "ZACA" Exped., 10 Aug. 1946 (SBMNH). Isla San Benito del Este: G. D. Hanna, CAS 1922 Exped. (Pilsbry 1927; CAS); J. W. Sefton, 6 Feb. 1950 (SBMNH); in talus just above beach, SW end of island, M. W. Williams, 26 Feb. 1941 (SBMNH).

Pilsbry (1913) discussed the provenance of the type material of *Helix pandorae*, originally stated to be from the vicinity of the Columbia River, Washington-Oregon. Johnson (1964) selected and illustrated a lectotype for *Helix damascenus* Gould.

Genus Eremarionta Pilsbry, 1913

Eremarionta indioensis (Yates, 1890)

(Fig. 35)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Cañon de Guadalupe, Sierra Juárez, E. P. Chace, 19 May 1957; W. B. Miller, 1 Jan. 1960 (WBM). Unnamed canyon ca. 10 mi [16 km] S of Cañon de Guadalupe, T. Danielson, 1958 (SBMNH). In decomposed granite on N exposure of left fork ca. 0.25 mi. above forks of Cañon Carrizo, E side of Sierra Juárez, R. S. Phair, 29 Nov. 1957 (SBMNH).

The various subspecies of *Eremarionta indioensis* were discussed at length by Pilsbry (1939). Specimens from the Sierra Juárez are not distinguishable from topotypes of *E. i. indioensis* from Indio, Riverside County, California, although these localities are separated by more than 150 km. The presence of *Eremarionta* in Baja California Norte was noted by Bequaert and Miller (1973), based on specimens from Cañon de Guadalupe.

***Eremarionta rowelli bechteli* (Emerson and Jacobson, 1964)**

(Fig. 35)

DISTRIBUTION.—SONORA: Isla San Esteban (TL), in rockslide, G D. Hanna, 1953 ORCA Exped.; elev. 300 m, R. V. Moran, 22 Mar. 1962, Belvedere Exped. (Emerson and Jacobson 1964; CAS, SDMNH, AMNH).

Although Isla San Esteban is politically a part of Sonora rather than of Baja California, the occurrence there of *Eremarionta* is included in the interest of a comprehensive listing of land snails of the gulf islands.

Other subspecies of *Eremarionta rowelli* (Newcomb, 1865) occur in the desert region of southeastern California and western Arizona and in the region of the Sierra de San Francisco and Puerto Libertad, Sonora (Bequaert and Miller 1973).

***Eremarionta* sp.**

(Fig. 36)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: S side of Paso San Matías, near N end of Sierra San Pedro Mártir, E. C. Jaeger, 8 Feb. 1955 (SBMNH). Near granite boulders on burned-over, juniper-covered hills 9 mi [14.4 km] W of Alaska, I. L. Wiggins, H. M. Hill, 4 Oct. 1946 (SBMNH).

Genus *Sonorelix* Berry, 1943**Subgenus *Herpeteros* Berry, 1947*****Sonorelix (Herpeteros) chacei* (Willett, 1940)**

(Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Lower end of El Tigre Canyon, about 9 mi [14.4 km] N of Ensenada (TL), E. P. and E. M. Chace, W. O. Gregg, G. Willett, 22 Feb. 1937, 21 Apr. 1940 (Willett 1940; LACM, CAS); S. S. Berry, H. L. Fletcher, 26 Jan. 1948 (SBMNH); R. L. Reeder, 8 Nov. 1973 (WBM).

This species is as yet known only from a small number of specimens collected at and near its type locality. It has not been dissected. *Sonorelix chacei* apparently differs from other Baja California forms in its relatively high-spired shell and nearly closed umbilicus, but its status must remain uncertain until more material becomes available for study.

***Sonorelix (Herpeteros) inglesiana* (Berry, 1928)**

(Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: On moist N slope of the Red Rock [Peña Colorada] under rocks, about 3 mi [4.8 km] from the sea and 0.5 mi [0.8 km] from Hamilton Ranch, W of Santo Domingo (TL), L. G. Ingles, 19 Dec. 1927

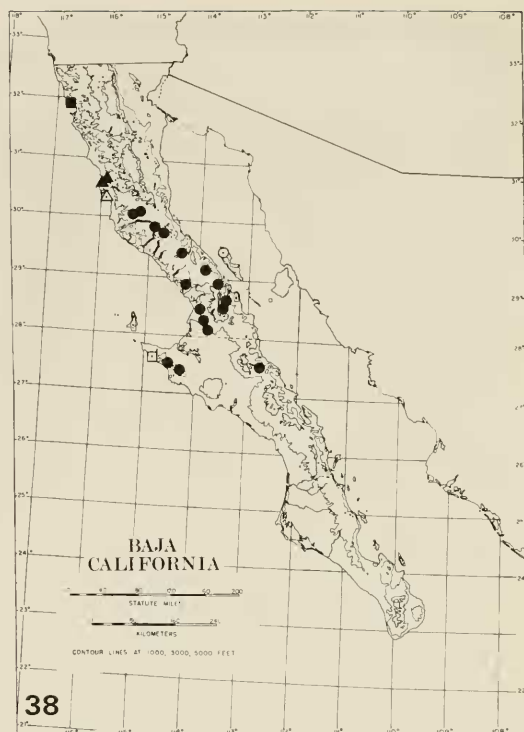


FIGURE 38. Distribution of *Sonorelix chacei* (solid square), *Sonorelix inglesiana* (solid triangles), *Sonorelix peninsularis* (solid circles), *Sonorelix evermanni* (open square), *Sonorelix merrilli* (open triangle), and *Sonorelix (Herpeteros) (?)* sp. (open circle).

(Berry 1928; SBMNH); G. Willett (CAS); I. L. Wiggins, H. M. Hill, 22 Oct. 1946 (Berry 1947; SBMNH). "Red Rock" at Hamilton Ranch, in fissures at top of letters "HR," W. B. Miller, W. N. Miller, 12 Dec. 1970; C. C. Christensen, W. B. Miller, 5 Nov. 1973 (WBM, CCC). Side canyon ca. 1 mi [1.6 km] above Misión Santo Domingo, W. Clune, 22 Mar. 1949 (SBMNH). Near Misión Santo Domingo, C. R. Orcutt, June 1919 (Berry 1928; SBMNH). San Antonio, near junction of Santo Domingo and Sanca streams, brushy hillside, elev. 2,200 ft [670 m], I. L. Wiggins, H. M. Hill, 13 Oct. 1946 (SBMNH).

Empty shells collected 2 mi [3.3 km] east of El Rosario by A. G. Smith, CAS 1958–1959 Exped. (CAS) and near El Rosario by S. C. Williams, 1969 (CAS) may belong to this species. Apparently, Orcutt collected similar shells in the vicinity of El Rosario prior to 1886 (Orcutt 1886).

The few intact specimens available for study are somewhat smaller than specimens from other locations identified by us as *S. peninsularis*, but do not differ significantly in shell form or umbilical size. The two taxa may be found to be conspecific when larger samples from the vicinity of Hamilton Ranch become available.

Sonorelix (Herpeteros) peninsularis (Pilsbry, 1916)

(Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: “Trinidad, on the west coast near San Borgia [Borja]” (TL), W. M. Gabb, 1867 (Pilsbry 1916). Foothills of the Sierra de Calmalli, about 30 mi [48 km] S of Misión San Borja (Gabb 1868, as *Helix remondi*). Two mi [3.2 km] back of Bahía de Los Ángeles, I. M. Johnston, CAS 1921 Exped. (Hanna 1923; CAS). About 1 mi [1.6 km] E of Misión San Borja, G. D. Hanna, I. L. Wiggins, CAS 1959 Exped. (CAS). North end of mountain W of Bahía de Los Ángeles, W. O. Gregg, 12 Oct. 1960 (CAS, SBMNH). 1.6 km S of Sauzalito Mine, C. Church, 23 Jan. 1971 (WBM). 1.6 km E of Rancho Arenoso along Mexico Rte. 1, in rockslides S of road, elev. 650 ft [200 m], W. B. Miller, W. N. Miller, 13 Dec. 1970 (WBM). 8 mi [13 km] N of El Progreso, E. S. Ross, D. Q. Cavagnaro, 1956 (CAS). 5 mi [8 km] W of Rancho Pénjamo, A. G. Smith, CAS 1961 Exped. (CAS). Agua Dulce Spring, in rocks on bluff S of the spring, elev. 2,200 ft [670 m], W. B. Miller, W. N. Miller, 13 Dec. 1970 (WBM). 17.0 mi [27.2 km] E of Desengaño along road to Bahía de Los Ángeles, in rocks, elev. 800 ft [140 m], W. B. Miller, W. N. Miller, 15 Dec. 1970 (WBM). 6.0 mi [9.7 km] S of Marmolito, A. G. Smith, I. L. Wiggins, CAS 1961 Exped. (CAS). 4.5 mi [7.2 km] NW of [Rancho] Mezquital, R. L. Bezey, W. C. Sherbrooke, 28 July 1965 (WBM). 4 mi [6.4 km] N of Rancho Mezquital, E. S. Ross, B. Hammerly, 1941 (SBMNH). 1 mi [1.6 km] and 5 mi [8 km] NW of Rancho Mezquital, A. G. Smith, CAS 1961 Exped. (CAS). Under dead agaves, summit of mesa just S of Rancho Mezquital, I. L. Wiggins, A. M. Vollmer, H. M. Hill, 8 Apr. 1961, CAS 1961 Exped. (Wiggins 1969); under dead agaves on rocky slope, elev. 500 ft [150 m], W. B. Miller, W. N. Miller, 17 Dec. 1970 (WBM). 6 mi [9.7 km] N of Cataviña, A. G. Smith, CAS 1961 Exped. (CAS). Arroyo Calamajué, 5 mi [8 km] S of the mission ruins, A. G. Smith, CAS 1961 Exped. (CAS). 7 mi [11 km] NNW of Rosarito, A. G. Smith, CAS 1961 Exped. (CAS). 15 mi [24 km] S of Punta Prieta, S. C. Williams, K. B. Blair, 7 July 1973 (CAS). BAJA CALIFORNIA SUR: 5.0 mi [8.0 km] E of San Ignacio, A. G. Smith, CAS 1961 Exped. (CAS). Sierra de Placeros, 22 mi [35 km] ESE of Bahía Tortugas, elev. 1,500 ft [460 m], D. E. Breedlove, 26 Mar. 1984 (CAS). Cerro de Banderilla, Sierra de Placeros, D. E. Breedlove, 24 Mar. 1984 (CAS).

For a discussion of the type locality of this species, see Hanna (1923:503–504). Miller (1972) figured the genitalia. Specimens from the Vizcaino Peninsula tend to be smaller than the usual *S. peninsularis* from farther north and more weakly sculptured, but identical shells are also found near Misión San Borja and in the vicinity of Bahía de Los Ángeles.

Sonorelix (Herpeteros) evermanni (Pilsbry, 1927) (Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Turtle Bay [Bahía Tortugas], N side (TL), G. D. Hanna, E. K. Jordan, June 1925 (Pilsbry 1927; CAS); H. Hemphill (CAS).

All known specimens are fossil. Taxonomic placement is provisional pending dissection of live-collected material.

Sonorelix (Herpeteros) merrilli (Bartsch, 1904) (Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Below San Quintín (TL), G. P. Merrill (Bartsch 1904; USNM).

No specimens besides the type lot have been collected. Taxonomic placement is provisional pending dissection of live-collected material.

Sonorelix (Herpeteros)(?) sp. (Fig. 38)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Puerto Refugio, Isla Ángel de la Guarda, CAS 1921 Exped. (Hanna 1923, as *Micrarionta* sp.; CAS).

An unidentified species of *Sonorelix* or *Ere-marionta*. Its presence on Isla Ángel de la Guarda is noteworthy.

Genus **Greggelix** Miller, 1972
Subgenus **Greggelix sensu stricto**

Greggelix (Greggelix) indigena (Mabille, 1895) (Fig. 39)

SYNONYMS.—*Helix digueti* Mabille, 1895. *Sonorella lohrii lioderna* Pilsbry, 1904.

DISTRIBUTION.—BAJA CALIFORNIA SUR: above 800 m on peaks of the Sierra, throughout most of the central part of the Peninsula of California (TL), L. Diguet (Mabille 1895; MNHN). San José Comondú and 12 mi [19 km] SW of San Miguel Comondú (probably fossil), R. J. Drake, July 1953 (CAS, SBMNH). Mesa de San Alejo, NW of San Javier, Sierra de la Giganta, elev. 800 m, A. Carter, 1961 (CAS). Arroyo de La Purísima, in a lava rockslide 3.0 mi [4.8 km] E of San Isidro, along road to Canipolé, W. B. Miller, 21 Dec. 1970 (Miller 1972; WBM). San José Comondú in a rockslide at the edge of town along road to San Javier, W. B. Miller, 20 Dec. 1970 (Miller 1972; WBM). Near Moleje [Mulegé] (Pilsbry 1904; TL of *Sonorella lohrii lioderna*; ANSP).

The type locality of *Greggelix indigena* was not stated precisely and that of *Helix digueti* not specified except as Baja California. The synonymy of these taxa was demonstrated by Miller (1972).

Greggelix (Greggelix) lohrii (Gabb, 1868) (Fig. 39)

SYNONYMS.—*Helix steganella* Mabille, 1895. *Helix invecta* Mabille, 1895.

DISTRIBUTION.—BAJA CALIFORNIA SUR: “Higher table lands near Moleje [Mulegé].” (TL), W. M. Gabb, 1867 (Gabb

1868, H. B. Baker 1963, Coan and Bogan 1988; ANSP). Above 800 m on the peaks of the Sierra, throughout most of the central part of the Peninsula of California, L. Diguët (Mabille 1895; TL of *Helix steganela*; MNHN). San Javier (SBMNH); immediately S of the mission, in immense rockslide, W. B. Miller, 24 Oct. 1971 (Miller 1981b; WBM).

The type locality of *Helix invecta* was not specified except as Baja California. The synonymy follows Miller (1972).

Greggelix (Greggelix) punctata Miller, 1981

(Fig. 39)

DISTRIBUTION.—BAJA CALIFORNIA SUR: Gulf slope of Sierra de la Giganta SW of Mulegé, along trail from Pie de la Cueta (2.9 mi [4.6 km] S of El Potrero) to Guajademi, in rockslide along trail about 1.5 mi [2.4 km] from Pie de la Cueta (or about 0.75 mi from trail summit), elev. ca. 2,450 ft [750 m] (TL). C. C. Christensen, W. B. Miller, R. L. Reeder, 23 Oct. 1972 (Miller 1981b; CAS). Guajademi, E. W. Nelson, E. A. Goldman, 30 Oct. 1905 (Miller 1981b; USNM).

Subgenus *Martirelix* Miller, 1982

Greggelix (Martirelix) babrakzai Miller, 1982

(Fig. 39)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Cañon Diablito, E slope of Sierra San Pedro Mártir, ca. 1 km up canyon from its mouth, among large granite boulders in decomposing granite, on right bank, elev. ca. 700 m (TL), R. H. Russell, W. B. Miller, 16 May 1970; N. Babrakzai, W. B. Miller, R. L. Reeder, 15 Mar. 1981 (Miller 1982; CAS). Cañon el Diablo, ca. 1.6 km N of Cañon Diablito, N. Babrakzai, W. B. Miller, R. L. Reeder, 15 Mar. 1981 (WBM). Canyon on E side of Sierra San Pedro Mártir, ca. 4 mi [6.4 km] NW of Algodón (rancho SW of San Felipe), E. C. Jaeger, 20 Dec. 1954 (SBMNH). Mouth of Cañon Borrego, ca. 3 mi [5 km] S of Cañon La Providencia, E side of Sierra San Pedro Mártir, E. C. Jaeger, G. A. Becker, 26 Jan. 1957 (SBMNH). Cañon Borrego, among granite rocks, elev. 1,100 ft [340 m], N. Briggs, 18 Dec. 1962 (SBMNH). 3 mi [5 km] and 0.5 mi [0.8 km] N of Colonia Morelia, Sierra San Pedro Mártir, 1 Jan. 1968 (SBMNH).

Greggelix (Martirelix) huertai Miller and Roth, sp. nov.

(Fig. 39)

DISTRIBUTION.—BAJA CALIFORNIA NORTE: Cerro de la Mina de San Juan, Sierra la Libertad, in rockpiles on north side of entrance to the mine, 28°42.5'N, 113°34.7'W, elev. ca. 1,300 m, W. B. Miller et al., 26 Nov. 1981 (WBM).

Subgenus uncertain

Greggelix sp.

(Fig. 39)

An undescribed fossil species of *Greggelix* has been found at a locality along the Transpenin-

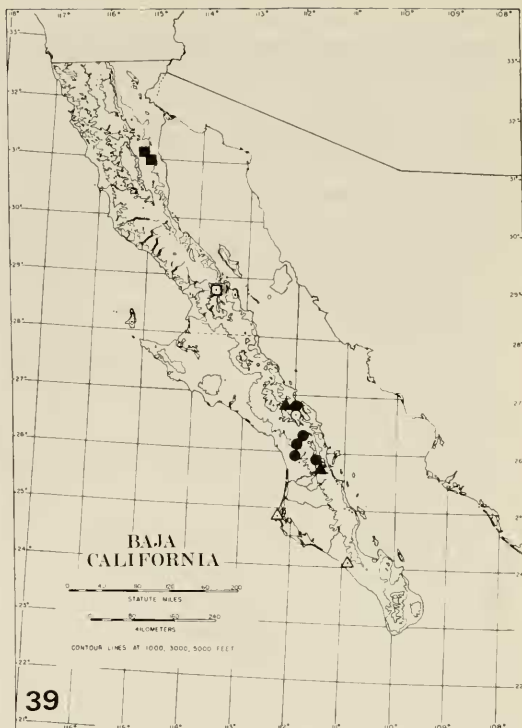


FIGURE 39. Distribution of *Greggelix indigena* (solid circles), *Greggelix loehrii* (solid triangles), *Greggelix punctata* (open circle), *Greggelix babrakzai* (solid squares), *Greggelix huertai* (open square), and *Greggelix* sp. (open triangle).

sular Highway at km 77, north of La Paz (WBM). A shell assignable to *Greggelix* was found in a fluvial-beach-terrace deposit at the north end of Cabo San Lázaro by J. T. Smith, 1985 (SBMNH).

SPECIES REPORTED FROM BAJA CALIFORNIA IN ERROR

The following species have been reported from Baja California but do not actually occur there. The names are given in the form in which the records were originally published.

Arionta rowelli (Newcomb, 1865). Record of fragments from Isla Guadalupe (Binney 1879) probably refers to *Helminthoglypta hannai hannai*.

Bulimulus (Scutalus) baileyi Dall, 1893. Dall's specimens from "Cape St. Lucas" were undoubtedly mislabeled, as the species has not been found in Baja California by recent workers. We have seen recent material from Sonora and Sinaloa.

Bulimulus proteus (Broderip, 1832). Baja Californian records by Binney (1861), Tryon (1867),

Binney and Bland (1869), Fischer and Crosse (1870–1902), and Cooper (1891) refer to *Naesiotus montezuma*, as Dall (1893a) noted.

Epiphragmophora arnheimi Dall, 1896. Reported from Nachoguero Valley [Cañada Macho Güero], Lower California (Dall 1896, 1897); the specimen, USNM 128949, proves to be *Helminthoglypta* sp., cf. *H. traskii isidroensis* (Bartsch, 1918). The specimen label specifies “Nachoguero Valley, San Diego Co.” (California), and we therefore exclude the record from Baja California.

Epiphragmophora ellipsostoma Pilsbry, 1894. Type locality stated to be “San Juan del Norte,” which Pilsbry (1894) inferred to be on the east coast of Baja California. The label with the holotype, ANSP 10745, states “San Juan del Norte, SE Nicaragua, W. M. Gabb,” the “SE Nicaragua” later scratched over in pencil. The specimen is a thin, light tan, strongly malleated shell, possibly belonging to a species of *Tryonigens* or *Lep- tarionta*. It has the appearance of a forest snail and is definitely not from Baja California. It may have been collected while Gabb was working as a geologist in Costa Rica, 1873–1876; his fossils from Costa Rica were bequeathed to ANSP (Dall 1909).

Gastrocopta dalliana dalliana (Sterki, 1898). Reported from Baja California by Bequaert and Miller (1973); here redetermined as *G. rixfordi*.

Gastrocopta procera (Gould, 1840). Reported from La Purísima (Bequaert and Miller 1973); here redetermined as *G. pellucida hordeacella*.

Hawaiia minuscula (Binney, 1840). Specimens so identified by Bequaert and Miller (1973) are here reassigned to *Hawaiia* sp.

Helix (Macrocyclis) duranti Newcomb, 1864. Record by Hemphill (1881) from near San Tomás River refers to *Haplotrema caelatum*.

Helix (or *Arionta*) *facta* Newcomb, 1864. Records from Isla Guadalupe (Binney 1879; Anonymous 1884; Cooper 1887) refer to *Micrarionta guadalupiana*.

Helix (Arionta) kellesti Forbes, 1850. Record by Hemphill (1881) from N of Todos Santos Bay probably refers to *Plesarionta stearnsiana*.

Helix remondi Tryon, 1863. Gabb's (1868) record from foothills of the Sierra de Calmallí refers to *Sonorelix peninsularis*.

Helix traskii var. *carpenteri* Newcomb, 1861. Record from Isla Guadalupe (Cooper 1892a) refers to *Helminthoglypta hannai hannai*. Records

from Islas Los Coronados (Hemphill 1881; Orcutt 1886; Cooper 1892a; Gratacap 1901, as *Arionta carpenteri*) refer to *Helminthoglypta traskii coronadoensis*. Hemphill's (1881) “*Helix (Arionta) carpenteri*” from Trinidad may refer to *Sonorelix peninsularis*.

Helix (Macrocyclis) voyana Newcomb, 1865. Record by Hemphill (1881) from Todos Santos Bay refers to *Haplotrema transfuga*.

Limax guatemalensis Crosse and Fischer, 1870. Record “dans les herbes au bord des torrents de la Laguna” (Mabille 1895) may refer to *Deroceras laeve*, which has been collected at La Laguna, Sierra de la Victoria, by Miller and Christensen.

Macrocyclis sportella (Gould, 1846). Records from “near United States boundary” (Orcutt 1886; Cooper 1892a) refer to *Haplotrema transfuga*.

Pupa chordata (Pfeiffer, 1856). Records from near Bahía San Quintín (Orcutt 1886; Cooper 1892a) refer to *Pupilla sterkiana*.

Selenites duranti var. *catalinensis* Hemphill in Binney, 1890. Binney's (1890) records from Punta Banda and San Tomás River refer to *Haplotrema caelatum*.

Succinea cingulata Forbes, 1850. Hemphill's (1881) record from near mouth of San Tomás River may refer to *S. californica*.

Succinea oregonensis Lea, 1841. Record from north of 31°N (Orcutt 1886) probably refers to species here provisionally allocated to *Catinella rehderi*.

BIOGEOGRAPHY

The native land mollusk fauna of Baja California (excluding the doubtful *Polygyra behri* from beach drift) consists of 117 species and subspecies, distributed among 36 genera of 18 families (Table 1). All but the two species of the amphibious prosobranch, *Truncatella*, are pulmonates. For the numerical part of the following analysis, the operational taxonomic unit is the species. Thus, for example, the three subspecies of *Nearctula rowelli* are treated as one taxon; the endemic Baja Californian subspecies *Glyptostoma newberryanum depressum* is treated as a representative of the largely Californian species *G. newberryanum*. The analysis includes the land mollusks of the gulf islands San Esteban and San Pedro Mártir, politically parts of Sonora; the only

taxon that would not otherwise be included is *Eremarionta rowelli bechteli*. Because of doubts about its true locality, *Spartocentrum eisenianum* is excluded. Four species (*Rabdotus*(?) sp., *Oxyloma nuttallianum*, *Sonorelix* (*Herpeteros*) *evermanni*, and *Greggelix* sp.) and one zonal occurrence of another (*Xerarionta areolata*) are known only from fossil shells. Although of interest for what they tell about distributional trends through time, these also are excluded from the numerical analysis. The final data set consists of 102 species.

The land mollusk fauna exhibits sharply distinct regional divisions (Miller 1973a, 1981b; Christensen 1979). To a large extent the molluscan zones correspond to other biological divisions proposed for the peninsula and adjacent islands. Shreve (1951) and Wiggins (1960b, 1980) recognized three major phytogeographic areas, which have met considerable acceptance by later authors: the northwest or Californian region, the Cape region, and the Sonoran Desert. Shreve (1951) divided the Baja Californian part of the Sonoran Desert into four subdivisions: Lower Colorado Valley, Central Gulf Coast, Vizcaino Region, and Magdalenan Region, each also having a vegetational and a floristic designation. Zoogeographic subdivisions proposed for the herpetofauna (Savage 1960; Murphy 1983) and scorpions (Williams 1980) have many points in common with those based on plants.

The molluscan faunal regions that we recognize (Fig. 40) depart only slightly from the phytogeographic regions. The primary divisions are the Californian, Sonoran, and Cape regions; subdivisions of the Californian and Sonoran regions are here termed "zones" (cf. Murphy 1983). All four possible types of zonal distribution occur: (a) single-zone endemics; (b) species endemic to a single zone in Baja California but also occurring extralimittally; (c) species restricted to Baja California but occurring in more than one zone; and (d) species present in more than one zone in Baja California and also occurring extralimittally (Tables 1, 2).

CALIFORNIAN REGION.—The Californian region (CA) extends west from the upper east slopes of the Sierra Juárez and Sierra San Pedro Mártir, above the (Sonoran) San Felipe Desert, to the Pacific coast and as far south as the southern margin of the Llano Santa María, inland from Bahía San Quintín. It includes the nearshore is-

lands Los Coronados, Todos Santos, and San Martín, and also Isla Guadalupe, approximately 275 km off the west coast. The region is largely a southern continuation of Munz and Keck's (1959) California Biotic Province. Its eastern boundary is relatively sharp but the transition southward to desert is more gradual. Rainfall is mainly from the northwest, in winter and spring, decreasing southward into the desert. Plant formations include coastal sage scrub, chaparral, and, above about 1,300–1,800 m, coniferous forest, which some workers (e.g., Wiggins 1980) treat as a separate floristic region.

Three subdivisions of the Californian region can be recognized: the Northern Montane zone (NM), approximately equivalent to the Baja California Coniferous Forest of Wiggins (1980); the Northwest Coastal zone (NC), extending from the foothills below the coniferous forest on the west slopes of the Sierra Juárez and Sierra San Pedro Mártir to the Pacific coast, including the nearshore islands; and Isla Guadalupe (IG).

In the Northern Montane zone are found *Pupilla hebes*, *Vallonia cyclophorella*, and *Euconulus fulvus*, species with wide distributions in the cordilleran region of the western United States. Although endemic plant species are rather common in the coniferous forest, the only single-zone endemic (category a) land mollusks thus far discovered are *Helminthoglypta reederi* and the unnamed *Helminthoglypta* species from the Sierra Juárez.

The land mollusk fauna of Isla Guadalupe is highly distinctive but of a Californian character. Although the island is floristically Sonoran, except for a small zone of coniferous forest (Wiggins 1980, map 4), the fauna contains no genera or species of mollusks that are otherwise restricted to the Sonoran Desert. *Truncatella guadalupensis* may be most closely related to a Caribbean or an Indo-Pacific species (Lindberg et al. 1980). All other species either have the remainder of their distribution in the Californian region (including the part of mainland California that belongs to the Peninsular Ranges physiographic province, and the islands of the southern California borderland) or have their closest relatives there.

The Northwest Coastal Zone shares only one species (*Nearctula rowelli*) with Isla Guadalupe, but its faunal affinities are much the same: the extralimittal ranges of species, or their closest rel-

TABLE 1. Distribution by region and zone of the land Mollusca of Baja California. Endemism categories: (a) single-zone endemic; (b) species endemic to a single zone in Baja California but also occurring extralimittally; (c) species restricted to Baja California but occurring in more than one zone; (d) species present in more than one zone in Baja California and also occurring extralimittally. Regions: CA, Californian; SO, Sonoran; CP, Cape. Zones: CD, Colorado Desert; GC, Gulf Coastal; IG, Isla Guadalupe; MG, Magdalenan; NC, Northwest Coastal; NM, Northern Montane; VI, Vizcaino Desert. * (asterisk) = fossil taxon.

Taxon	Endemism category	Region and zone
Prosobranchia		
Truncatellidae		
<i>Truncatella californica</i>	(b)	CA (NC)
<i>T. guadalupensis</i>	(a)	CA (IG)
Pulmonata		
Pupillidae		
<i>Gastrocopta (G.) pellucida hordeacella</i>	(d)	SO (MG, GC), CP
<i>G. (G.) sp., cf. G. (G.) riograndensis</i>	(b)	SO (GC)
<i>G. (Immersidens) allyni</i>	(a)	CP
<i>G. (I.) rixfordi</i>	(c)	SO (MG, GC), CP
<i>Pupilla (P.) hebes</i>	(b)	CA (NM)
<i>P. (Striopupilla) sterkiana</i>	(a)	CA (NC)
<i>P. (S.) goniodon</i>	(c)	CA (IG), SO (VI)
<i>P. (S.) guadalupensis</i>	(a)	CA (IG)
<i>Pupoides albilabris</i>	(d)	SO (MG, GC), CP
<i>P. catalinensis</i>	(a)	SO (GC)
<i>Vertigo (V.) berryi</i>	(b)	CA (NC)
<i>V. (V.) ovata</i>	(b)	CP
<i>Nearctula rowelli</i>	(d)	
<i>diegoensis</i>		CA (IG, NC)
<i>catalinaria</i>		CA (IG, NM)
<i>guadalupensis</i>		CA (IG)
<i>N. degeneris</i>	(a)	CA (IG)
<i>Sterkia (S.) calamitosa</i>	(a)	
<i>calamitosa</i>		CA (NC)
<i>martiniana</i>		CA (NC)
<i>S. (S.) hemphilli</i>	(d)	CA (NC), SO (VI)
<i>S. (Metasterkia) clementina</i>	(b)	CA (IG)
Valloniidae		
<i>Vallonia cyclophorella</i>	(b)	CA (NM)
Strobilopsidae		
<i>Strobilops californica</i>	(a)	CP
Subulinidae		
<i>Lamellaxis gracilis</i> (introduced)		CP
<i>Opeas pumilum</i> (introduced)		CP
Haplotrematidae		
<i>Haplotrema (H.) guadalupense</i>	(a)	CA (IG)
<i>H. (H.) transfuga</i>	(b)	CA (NC)
<i>H. (Geomene) caelatum</i>	(b)	CA (NC)
Bulimulidae		
<i>Naesiotus(?) altus</i>	(a)	CP
<i>N. beldingi</i>	(a)	CP
<i>N. cosmicus</i>	(a)	CP
<i>N. dentifer</i>	(c)	
<i>dentifer</i>		SO (GC)
<i>johnstoni</i>		SO (GC)
<i>lamellifer</i>		SO (VI, MG, GC)
<i>slevini</i>		SO (GC)
<i>N. excelsus</i>	(a)	CP
<i>N. gabbi</i>	(a)	SO (MG)

TABLE 1. Continued.

Taxon	Endemism category	Region and zone
<i>N. gigantensis</i>	(c)	SO (MG, GC)
<i>N. hannai</i>	(a)	SO (MG)
<i>N. harribaueri</i>	(a)	CP
<i>N. laevapex</i>	(a)	SO (GC)
<i>N. montezuma</i>	(a)	CP
<i>N. pallidior</i>	(a)	CP
<i>N. rimatus</i>	(a)	CP
<i>N. spirifer</i>	(a)	CP
<i>N. veseyianus</i>	(a)	SO (GC)
<i>N. xantusi</i>	(a)	CP
<i>N.(?) sp.</i>	(a)	CP
<i>Rabdotus (R.) ceralboensis</i>	(a)	SO (GC)
<i>R. (R.) chamberlini</i>	(a)	SO (GC)
<i>R. (R.) levis</i>	(a)	CP
<i>R. (R.) pilula</i>	(a)	CP
<i>R. (R.) sufflatus</i>	(c)	SO (MG, GC), CP
<i>R. (Plicolumna) abbreviatus</i>	(a)	CP
<i>R. (P.) artemisia</i>	(c)	SO (GC), CP
<i>R. (P.) inscendens</i>	(c)	SO (GC), CP
<i>R. (P.) perhirsutus</i>	(a)	CP
<i>R. (P.) ramentosus</i>	(a)	CP
* <i>R.(?) sp.</i>	(a)	SO (GC)
<i>Berendtia taylora</i>	(c)	SO (MG, GC)
<i>Spartocentrum digueti</i>	(a)	SO (MG)
<i>S. eisenianum</i>		CP?
<i>S. insulare</i>	(a)	SO (GC)
<i>S. irregulare</i>	(c)	SO (MG, GC)
<i>S. vanduzeei</i>	(a)	SO (GC)
<i>S. sp.</i>	(a)	SO (MG)
Punctidae		
<i>Paralaoma caputspinulae</i>	(b)	CA (NC)
Helicodiscidae		
<i>Helicodiscus (Hebetodiscus) singleyanus</i>	(d)	SO (GC), CP
Arionidae		
<i>Binneya (B.) notabilis</i>	(b)	CA (NC)
<i>B. (Allothyra) guadalupensis</i>	(a)	CA (IG)
Succineidae		
<i>Succinea californica</i>	(a)	CA (NC)
<i>S. guadelupensis</i>	(a)	CA (IG)
<i>S. rusticana</i>	(d)	CA (NC), SO (VI), CP
<i>Catinella rehderi</i>	(d)	CA (NC), SO (VI, MG), CP
* <i>Oxyloma nuttallianum</i>	(b)	SO (MG)
Helicarionidae		
<i>Euconulus fulvus</i>	(b)	CA (NM)
Zonitidae		
<i>Glyphyalinia indentata paucilirata</i>	(d)	SO (MG), CP
<i>Striatura (Pseudohyalina) pugetensis</i>	(b)	CA (IG)
<i>Hawaiiia sp.</i>	(d?)	SO (MG), CP
Limacidae		
<i>Milax gagates</i> (introduced)		CA (NC)
<i>Deroceras laeve</i>	(d)	CA (NC), CP
Polygyridae		
[<i>Polygyra (Erymodon) behri</i>		SO (GC)—doubtful]

TABLE I. Continued.

Taxon	Endemism category	Region and zone
Thysanophoridae		
<i>Thysanophora hornii</i>	(d)	SO (MG, GC), CP
Oleacinidae		
<i>Pseudosubulina eiseniana</i>	(a)	CP
<i>P. tastensis</i>	(a)	CP
Megomphicidae		
<i>Glyptostoma newberryanum depressum</i>	(b)	CA (NC)
Orcoheliciidae		
<i>Radiocentrum discus</i>	(a)	CP
<i>R. exorbitans</i>	(c)	SO (MG), CP
Helminthoglyptidae		
<i>Helminthoglypta (H.) tudiculata</i>	(b)	CA (NC)
<i>H. (Charodotes) hannai</i>	(a)	
<i>hannai</i>		CA (IG)
<i>diodon</i>		CA (IG)
<i>H. (C.) coelata</i>	(b)	CA (NC)
<i>H. (C.) misiona</i>	(a)	CA (NC)
<i>H. (C.) reederi</i>	(a)	CA (NM)
<i>H. (C.) traskii</i>	(b)	
<i>coronadoensis</i>		CA (NC)
subsp.		CA (NC)
<i>H. (subgenus?) sp.</i>	(a)	CA (NM)
<i>Micrarionta guadalupiana</i>	(a)	CA (IG)
<i>Plesarionta orcutti</i>	(a)	CA (NC)
<i>P. stearnsiana</i>	(d)	CA (NC), SO (VI)
<i>Xerarionta areolata</i>	(a)	SO (MG) (*GC)
<i>X. levis</i>	(c)	
<i>levis</i>		CA (NC), SO (VI)
<i>canescens</i>		SO (VI)
* <i>crassula</i>		SO (VI)
<i>X. pandorae</i>	(a)	SO (VI)
<i>Eremarionta indioensis</i>	(b)	SO (CD)
<i>E. rowelli bechteli</i>	(b)	SO (GC)
<i>E. sp.</i>	(a)	SO (CD)
<i>Sonorelix (Herpeteros) chacei</i>	(a)	CA (NC)
<i>S. (H.) inglesiana</i>	(a)	CA (NC)
<i>S. (H.) peninsularis</i>	(c)	SO (VI, MG, GC)
* <i>S. (H.) evermanni</i>	(a)	SO (VI)
<i>S. (H.) merrilli</i>	(a)	CA (NC)
<i>S. (H.)(?) sp.</i>	(a)	SO (GC)
<i>Greggelix (G.) indigena</i>	(c)	SO (MG, GC)
<i>G. (G.) loehrui</i>	(a)	SO (MG)
<i>G. (G.) punctata</i>	(a)	SO (MG)
<i>G. (Martirelix) babrakzai</i>	(a)	SO (CD)
<i>G. (M.) huertai</i>	(a)	SO (VI)
* <i>G. (subgenus?) sp.</i>	(a)	CP

atives, occur in the Peninsular Ranges part of southern California or on the borderland islands. *Sterkia hemphilli* also occurs farther south at Punta Abreojos, the southern limit of the genus in western North America (Christensen 1979). The Baja Californian endemic subgenus *Pupilla*

(*Striopupilla*) is limited to the Californian region except for the occurrence of *P. (S.) goniodon* on Isla San Benito del Oeste. The occurrences of *S. hemphilli* and *P. (S.) goniodon* in the Sonoran region are probably relicts of the formerly greater extent of the Californian region, now reduced by

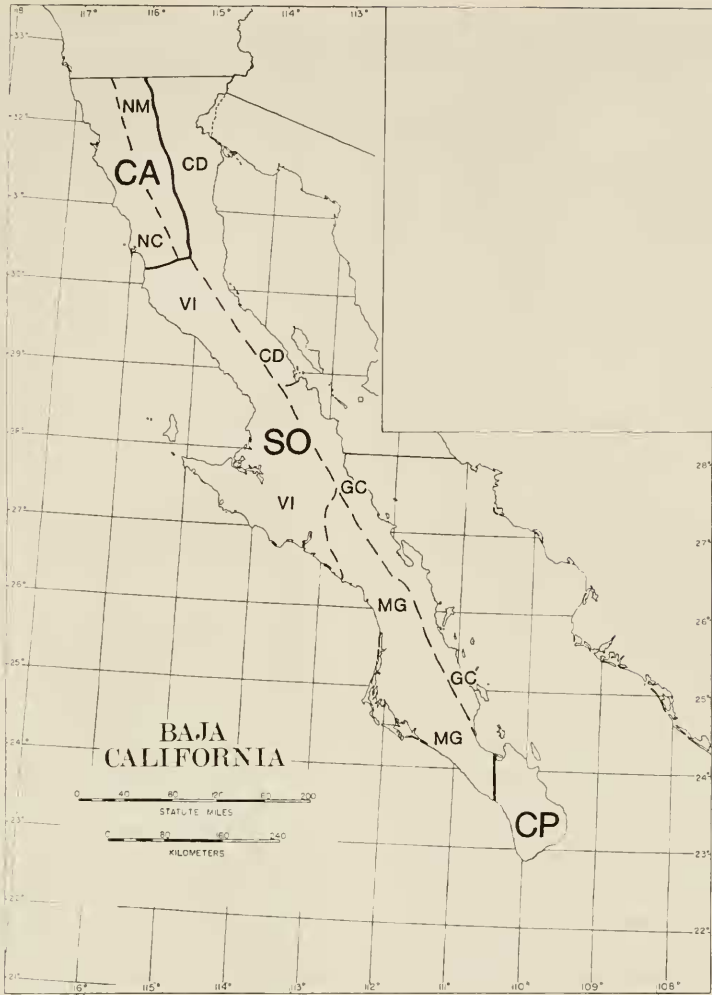


FIGURE 40. Molluscan faunal regions and zones defined in this report. Abbreviations for regions: CA, Californian; SO, Sonoran; CP, Cape. Abbreviations for zones: NC, Northwest Coastal; NM, Northern Montane; CD, Colorado Desert; VI, Vizcaino Desert; GC, Gulf Coastal; MG, Magdalenan. Not shown: IG, Isla Guadalupe zone of Californian region.

late Quaternary encroachment of the arid Sonoran environment (Axelrod 1979).

Except for one isolated, probably relict occurrence in the Sierra La Libertad, the genus *Plesarionta* is limited to the Californian region. The northern limit of *Xerarionta* in Baja California occurs slightly north of the southern interface between the Californian and Sonoran regions. The genus reappears on the southern California Channel Islands and the adjacent mainland of Los Angeles County. The present range of *Plesarionta* and *Xerarionta* coincides closely with the extent of fog from the Pacific Ocean (Miller 1973a; Christensen 1979). Pleistocene or early

Holocene fossils of *Xerarionta areolata* on the east side of the peninsula and on the gulf islands of Monserrate and Espíritu Santo suggest that the influence of maritime fog was formerly more widespread.

The slug *Deroceras laeve* is shared with the Cape region; this species also ranges north to the Arctic and south to Central America. The succineids *Succinea rusticana* and *Catinella rehderi*, shared with the Cape and Sonoran regions, range to the Pacific Northwest. However, as noted earlier, these identifications based on shells alone are provisional.

Nearshore islands and island groups of the

TABLE 2. Summary of land mollusk fauna of Baja California by region, zone, and endemism category. Endemism categories as in Table 1. Numbers in parentheses = fossil taxa (additional to living taxa).

Region and zone	Regional/zonal distribution of species				Total
	(a)	(b)	(c)	(d)	
Californian (CA)	18	15	2	6	41
Northwest Coastal (NC)	8	10	1	6	25
Northern Montane (NM)	2	3	0	1	6
Isla Guadalupe (IG)	8	2	1	1	12
Sonoran (SO)	19 (2)	3 (1)	13	10	45 (3)
Colorado Desert (CD)	2	1	0	0	3
Vizcaino Desert (VI)	2 (1)	0	4	4	10 (1)
Magdalenan (MG)	7	0 (1)	9	6	22 (1)
Gulf Coastal (GC)	8 (1)	2	10 (1)	4	24 (2)
Cape (CP)	21 (1)	1	5	9	36 (1)

Northwest Coastal zone show a relatively low level of endemism. *Helminthoglypta traskii coronadoensis* on the Islas Los Coronados and *Sterkia calamitosa martiniana* on Isla San Martín are only subspecifically distinct from mainland populations. The other insular taxa do not show even this level of differentiation.

SONORAN REGION.—The truly arid region lying between the Californian and Cape regions is part of the Sonoran Desert, which also extends into Sonora, Arizona, and southeastern California (Shreve 1951; Axelrod 1979). About 70 per cent of the area of Baja California is desert (Gould and Moran 1981), including the gulf islands.

As an arid environment of regional extent, the Sonoran Desert is a young feature, emerging particularly in late Pliocene and Pleistocene interglacial stages, perhaps most strongly since the close of the Wisconsinan glacial stage (Axelrod 1979, fig. 37). Its development has interrupted the formerly continuous distribution of many plant species, such as the disjunct chaparral vegetation of California and Arizona and species of the insular and maritime flora of southern California with their nearest allies in the Sierra Madre Occidental of Mexico (Axelrod 1979:9–11). The ranges of some molluscan taxa have been similarly interrupted. *Radiocentrum*, with species in the Cape region of Baja California, in southern Arizona and New Mexico, and on Santa Catalina Island, California, shows trans-Sonoran disjunction (Hochberg et al. 1987). *Gastrocopta allyni* (allied to *G. ashmuni* (Sterki) and *G. cochisensis* (Pilsbry and Ferriss) of Arizona and New Mexico), *Vertigo ovata*, and perhaps *Gastrocopta*

riograndensis may represent the same type of distribution. *Deroceras laeve* occurs in the Californian and Cape regions but not in the Sonoran region.

The Colorado Desert zone (CD) is equivalent to the Baja Californian part of the Lower Colorado Valley (=microphyllous desert, =*Larrea-Franseria* region) of Shreve (1951). It lies between the lower east slopes of the Sierra Juárez and Sierra San Pedro Mártir and the Gulf of California and extends as far south as Bahía de Los Ángeles. Beyond Baja California, the microphyllous desert extends into southern California, Arizona, and Sonora. This zone is one of the hottest and most arid of the Sonoran region. The mountains to the west isolate it from Pacific breezes; both summer and winter rainfall are sporadic. The most characteristic plant formation is *Larrea* (creosote bush) scrub, but large areas are sandy plains with little perennial vegetation.

Land mollusks are rare and confined to canyons of the larger ranges. *Eremarionta* is found in canyons on the eastern slopes of the Sierra Juárez and Sierra San Pedro Mártir. It also occurs on Isla San Esteban in the gulf and in Sonora as far south as Puerto Libertad, in zones of sarcocaulescent desert. Distribution of snails of this genus in low mountain ranges in the Mojave, Colorado, and Yuma deserts of southern California and western Arizona (Bequaert and Miller 1973, fig. 2) suggests a correlation with the northward extent of the Gulf of California in Pliocene time. Marine fossils and sediments indicate that a Pliocene gulf extended as far north as San Gor-

gonio Pass, in the San Bernardino Mountains, California (Allen 1957). At that time the San Gabriel and San Bernardino ranges had not yet undergone their major uplift (Axelrod 1979), and were not blocking moisture from regions to the east as they do today. Marine microfossils from drill cores taken in Cadiz and Danby dry lakes, eastern San Bernardino County, indicate a similar northward extension of marine conditions nearer to the present course of the Colorado River (Bassett et al. 1959), probably during the Pliocene. Most modern occurrences of *Eremarionta* are within or adjacent to the shoreline inferred for the maximum Pliocene extent of seas (Durham and Allison 1960, fig. 5). Thus the distribution of this, one of the most xerophilic of North American land snail genera, may originally have come about under basically maritime conditions.

The subgenus *Greggelix* (*Martirelix*) is restricted to this zone except for *G. (M.) huertai* at a single locality in the Sierra La Libertad, near the northern end of the Vizcaino Desert zone.

Because the Colorado Desert zone has no species in common with any other zone, there might be some logic in regarding it as a primary faunal division. However, in the arid environment where extreme isolation fosters a high degree of short-range, allopatric endemism, shared genera or subgenera are likely to be better indicators of faunal affinity than species. (As Page [1987] has pointed out, non-uniform taxonomic treatments hamper comparisons between biotas and, at least at present, taxonomic categories are not broadly intercomparable.) At the generic (*Eremarionta*) and subgeneric (*Martirelix*) level, the Colorado Desert zone shows closest affinity to the Gulf Coast and Vizcaino Desert zones of the Sonoran region.

The Vizcaino Desert zone (VI) is equivalent to the Vizcaino Region (=sarcophyllous desert, =*Agave-Franseria* region) of Shreve (1951). It occupies approximately the central third of the peninsula west of the crest of the mountains and shares a roughly north-south boundary with the Magdalenan zone at about 113°W. There is light winter and early spring rainfall, more sporadic in the south and interior than in the north, and rare summer rainfall in the Sierras Calamajué, San Borja, and Calmalli along the eastern edge of the zone. A narrow coastal strip about 10 km wide is influenced by the humidity of Pacific Ocean winds and fog. Vegetationally the zone is

characterized by succulent-leaved plants such as *Agave* and *Dudleya*, and in many areas a dense growth of lichens. Vast areas are caliche flats or alkaline plains with *Atriplex* scrub and support no land mollusks.

Few species occur in this zone, and only two (20%), *Xerarionta pandorae* of the Islas San Benito and *Greggelix (Martirelix) huertai* from the Sierra La Libertad, are single-zone endemics. *Sonorelix (Herpeteros) evermanni*, as yet known only from fossil specimens, may be another. *Xerarionta levis*, locally abundant under favorable conditions, laps into the southern part of the Northwest Coastal zone. *Sonorelix (Herpeteros) peninsularis* has peripheral localities in the Magdalenan and Gulf Coastal zones. Related species of *Sonorelix (Herpeteros)* occur in the Californian region, as far north as Los Angeles County. *Plesarionta stearnsiana* and *Naesiotus dentifer*, predominantly species of the Northwest Coastal and Magdalenan-Gulf Coastal zones respectively, occur marginally within the Vizcaino Desert zone. Two succineids are shared with both the Californian and Cape regions. The 80% of taxa shared with other Baja Californian zones (category c and d species) support Christensen's (1983) characterization of the central part of the peninsula as a zone of transition between northern and southern faunas.

The islands of the Vizcaino Desert zone show a moderate level of endemism: *Xerarionta pandorae* on the San Benitos, and two subspecies (one extinct) of *Xerarionta levis* on Islas Cedros, Natividad, and San Gerónimo. Populations of *X. levis* on Isla Asunción are assigned to the nominate subspecies.

The Magdalenan zone (MG) includes the desert of the southern third of the peninsula, from the drainage divide of the Sierra de la Giganta to the Pacific coast, almost as far south as Todos Santos. Regions of arid tropical scrub and dry tropic forest in the Sierra de la Giganta have previously been excluded from the definition of Sonoran Desert (Axelrod 1979; Wiggins 1980). The parts of that range that have been explored for land mollusks have yielded a fauna that strongly resembles those of the adjacent parts of the Magdalenan and Gulf Coastal zones, and therefore we do not recognize a separate zone for the Gigantas. The coastal strip of the Magdalenan zone is subject to much the same type of marine influence as the coast of the Vizcaino

Desert zone. On the Pacific coast most rain falls in the late winter; in the interior there are summer thunderstorms as well. A diversity of plant formations is present; Shreve (1951) regarded a joint dominance of trees and large succulents to be characteristic of the zone. In the southern half of the zone the desert vegetation intermingles with dry tropic forest typical of the Cape region; in the lower foothills of the Sierra de la Giganta it grades into tropical scrub.

The zonal endemics belong to *Naesiotus* and the characteristically Baja Californian genera *Spartocentrum* and *Greggelix*. *Xerarionta areolata* is a zonal endemic as a Recent species, but occurs as Pleistocene or early Holocene fossils in the Gulf Coastal zone. The Magdalenan zone contains the only Baja Californian occurrence (as empty shells, possibly fossil) of *Oxyloma nuttallianum*, which ranges through California to the Pacific Northwest. The zone shares 11 taxa with the Gulf Coastal zone and nine with the Cape region. Four of these are wide-ranging taxa that also extend into the arid southwestern United States and for various distances into Mexico (*Glyphyalinia indentata paucilirata*, *Thysanophora hornii*), Central America (*Gastrocopta pelucida hordeacella*), and South America (*Pupoides albilabris*). The other shared taxa belong to the genera *Naesiotus*, *Rabdotus*, *Berendtia*, *Spartocentrum*, *Sonorelix* (*Herpeteros*), and *Greggelix* (*Greggelix*). The only island endemic in the zone is *Naesiotus hannai* on Islas Margarita and Magdalena; the only other land mollusk reported from these islands is the common peninsular *Xerarionta areolata*.

The Gulf Coastal zone (GC) includes all of the islands of the Gulf of California and a strip along the east coast of the peninsula from Bahía de Los Ángeles to the west side of Bahía de La Paz. The zone is largely equivalent to the insular and Baja Californian parts of the Central Gulf Coast (=sarcocaulis desert, =*Bursera-Jatropha* region) of Shreve (1951). Sarcocaulis desert vegetation also occurs in two narrow coastal strips on the extreme eastern edge of the Cape region. The molluscan fauna of these strips consists entirely of species also found farther west, in the Cape molluscan region; they are therefore included in that region. Rainfall in the Gulf Coastal zone is very low and uncertain, occurring in either late winter or midsummer but often absent for several seasons in succession. The character-

istic vegetation includes shrubs and small trees with swollen-appearing trunks.

The zonal endemics belong mainly to the genera *Naesiotus*, *Rabdotus*, and *Spartocentrum*. *Pupoides catalinensis* is an endemic species related to the widespread Neotropical *P. albilabris*. *Eremarionta rowelli bechteli* is an endemic subspecies of a species that ranges to the Mojave and Colorado deserts. The probable *Sonorelix* (*Herpeteros*) species from Isla Ángel de la Guarda belongs to a subgenus that ranges through the Vizcaino Desert zone into the Californian region. *Gastrocopta* sp. (cf. *G. riograndensis*) may be the same species as *G. riograndensis* of Texas and northeastern Mexico. The zone shares 11 taxa with the Magdalenan zone and eight with the Cape region, with geographic affinities sorting out much like those of the Magdalenan zone.

Twenty-one taxa are recorded from the islands of the Gulf of California. Eleven (including three subspecies of *Naesiotus dentifer* and one of *Eremarionta rowelli*) do not occur anywhere on the mainland. Twelve of the 16 island occurrences of these insular endemics are on "non-land-bridge" islands—those separated from the mainland by channel depths greater than 130 m, which therefore would not have had peninsular connections during the lowest sea levels of the Wisconsinan glacial stage. In contrast, 16 of 33 island occurrences of taxa which are not insular endemics are on non-land-bridge islands. However, the difference between the two endemism categories is not significant, whether all land mollusks are considered ($\chi^2 = 2.105$, $0.20 > P > 0.10$) or only those with adult shell size greater than 10 mm ($\chi^2 = 3.506$, $0.10 > P > 0.05$).

CAPE REGION.—The Cape region (CP) is equivalent to the Arid Tropical Region of Wiggins (1980) plus the two strips of sarcocaulis desert along the Cape's eastern shore, and includes the entire southern end of the peninsula south of the Sierra de la Giganta. The dominant plant formations are arid tropic scrub, dry tropic forest, and on the higher peaks of the Sierra de la Victoria, pine and oak woodland.

The rate of single-zone (category a) endemism is high (58%) and largely accounted for by diversity in *Naesiotus* and *Rabdotus*. The region shares nine taxa with the Magdalenan and eight with the Gulf Coastal zone, six of these being wide-ranging taxa extending to or through the arid southwestern United States. The slug *Dero-*

TABLE 3. Membership of monophyletic groups (each consisting of one or more Baja Californian species) in generalized tracks. Numbers in parentheses = fossil taxa (additional to living taxa).

Region and zone	Generalized track				
	Peninsular Ranges-Calif. Borderland	Cordilleran	Colorado/Mojave Desert	Neotropical	Arizona-Northern Mexico
Californian (CA)	23	5	0	1	1
Northwest Coastal (NC)	17	2	0	0	1
Northern Montane (NM)	3	3	0	0	0
Isla Guadalupe (IG)	7	1	0	1	0
Sonoran (SO)	7 (2)	1	2	5	4
Colorado Desert (CD)	0	0	1	0	1
Vizcaino Desert (VI)	6	1	0	0	1
Magdalenan (MG)	3 (1)	0	0	3	4
Gulf Coastal (GC)	1 (1)	0	1	5	4
Cape (CP)	2	1	0	6	8

ceras laeve and two succineids are shared with the Californian region, the succineids with the Vizcaino Desert zone as well.

"TRACK RECORD"

Lines on a map connecting the taxa of Baja California with their sister taxa elsewhere—"tracks" in the parlance of vicariance biogeography, which adopted it from the Panbiogeography of Croizat (1964:7; see Rosen 1976; Page 1987)—coincide to form a small number of generalized tracks. "Sister taxa" in this context means either the disjunct populations of a species or the disjunct species of a monophyletic group. The delineation of tracks as a descriptive device does not in itself imply either a dispersal or vicariance explanation of the historical relationship between the taxa so connected.

Resolution of the biogeographic history of a monophyletic group is sometimes said to require a statement of the cladistic relationships of its component taxa—at the minimum, a three-taxon statement of the form "taxon *a* and taxon *b* are more closely related than either is to taxon *c*." Few groups of North American land mollusks have been subjected to this type of analysis; therefore, most of the sister-taxon relationships cited here are based on inspection of standard monographs of the groups involved (e.g., Pilsbry 1939–48; Christensen 1978). Future phylogenetic studies will permit refinement of the conclusions presented here. The five generalized

tracks are described below; their membership is summarized in Table 3.

1. Peninsular Ranges-California Borderland Track. As previously noted, northwestern Baja California is commonly viewed as part of a Californian biotic province. Many species' ranges extend north through the Peninsular Ranges and the islands off the southern California coast at least as far as the Transverse Ranges. A substantial number of these tracks further extend to the Pacific Northwest, Alaska, and (in the case of *Paralaoma caputspinulae*) even to Kamchatka.

Vertigo berryi extends north to the Transverse Ranges and thence to the Spring Range, Nevada (Pratt 1976); as a Quaternary fossil it occurs in Arizona, Nevada, and southeastern California. The genus *Nearctula* ranges along the coast of California as far north as the San Francisco Bay area; some subspecific differentiation occurs on the Borderland islands. Both subgenera of *Haplotrema* range into coastal southern California; *Haplotrema sensu stricto* also extends northward to the North Coast Ranges in Mendocino County (Roth, in press). *Binneya* occurs on the California Borderland islands.

Succinea rusticana, *Catinella rehderi*, *Oxyloma nuttallianum*, and *Striatura pugetensis* range through southern California to the Pacific Northwest. Author Miller has dissected specimens of *Succinea* from the Salinas Valley, California, which prove to be similar or identical to *S. californica*. Affinities of the undissected *Succinea*

guadelupensis are unknown, but conchologically similar specimens (placement in *Succinea* confirmed by Roth's dissection) occur on San Nicolas Island, California.

Helminthoglypta (*H.*) *tudiculata* extends north to the Transverse Ranges; related species extend northward along the west side of the Sierra Nevada. *Helminthoglypta* (*Charodotes*) occupies a similar range as far north as the north side of the Transverse Ranges. The distribution of *Plesarionta* and *Xerarionta* (the two genera differ anatomically only in the presence or absence of a verge at the summit of the penial sac) participates in this track and during the Pleistocene or early Holocene extended to the Gulf Coastal zone. However, a species of *Xerarionta* has been described from the Eocene of Trans-Pecos Texas (Roth 1984), where it occurs with the camaenid genus *Pleurodonte*, now restricted to the Greater Antilles. Thus, the history of *Xerarionta* and *Plesarionta* may also involve the Neotropical track. *Sonorelix* (*Herpeteros*) is endemic to Baja California, with the exception of one species, *Sonorelix* (*Herpeteros*) *angelus* Gregg, 1949, in the Transverse Ranges. The presumed sister taxon, *Sonorelix* sensu stricto, is endemic to the Mojave and Colorado deserts.

2. Cordilleran Track. Taxa of this group range through the higher mountain chains of western North America, in some cases to Arctic or Subarctic regions. Many of the genera are Holarctic. Some elements, such as *Deroceras laeve*, extend south in mesic situations as far as Central America. Others also occur in isolated montane settings such as the San Bernardino Mountains of California. Bequaert and Miller (1973, see especially pp. 57-64) summarized the ranges of many Cordilleran taxa.

Pupilla (*Striopupilla*) is an endemic Baja Californian subgenus; its presumed sister taxon is the Holarctic *Pupilla*, sensu stricto, with several species in the North American Cordillera. (Pilsbry [1948] regarded *P.* (*Striopupilla*) as representing an immigrant Asian stock, presumably by way of the North Pacific arc; however, he did not specify any plausible Asian sister-group.) *Vallonia cyclophorella* is widespread in the Cordilleran region. *Euconulus fulvus* is Holarctic, with montane southward extensions to southern California, Baja California, and Chihuahua (Bequaert and Miller 1973).

3. Colorado/Mojave Desert Track. *Eremari-*

onta connects the Colorado Desert and Gulf Coastal zones with southeastern California and extreme western Arizona. The sister taxon of *Eremarionta* may be *Micrarionta* of the California borderland, in which case a vicariant relationship related to the rise of the Peninsular Ranges and the San Bernardino-San Gabriel Mountains is indicated. The relationship between Baja Californian and extralimital *Eremarionta* is subspecific and readily accounted for by isolation resulting from the increasing aridity of the Sonoran desert environment (Axelrod 1979).

4. Neotropical Track. Paleontological evidence is mounting that during the late Cretaceous and early Tertiary, a land snail fauna consisting partly of genera of the modern tropics was arrayed across the southern part of North America, roughly parallel to the western limb of the Tethyan seaway (Roth 1988). Through the Cenozoic, the northern, antitropical limits of this fauna retreated southward. At the same time, the east-west ranges of taxa were more or less disrupted by tectonic events and their consequent climatic effects. Participants in an east-west Neotropical track include *Gastrocopta pellucida hordeacella*; *Pupoides*; *Sterkia*, with species in the California borderland and Mesoamerica; and probably *Helicodiscus* (*Hebetodiscus*), which ranges across the eastern United States and Mexico but is most diverse on the islands of the Greater Antilles (Pilsbry 1948). The genus *Pseudosubulina* extends to Central America and the Greater Antilles. Distribution of the genus *Strobilopsis* is complex (cf. Pilsbry 1948:fig. 461) and the subgeneric assignment of *S. californica* uncertain (Miller and Christensen 1980). It is tentatively referred to the group of taxa having Neotropical tracks.

Bequaert and Miller (1973) regarded *Hawaiiia minuscula* and *Glyphyalinia indentata paucilirata* as part of a "pan-American" element in their Nearctic Southwestern Molluscan Province, but because of open questions regarding the taxonomy of western American records, we exclude them from further analysis here.

Truncatella guadalupensis probably participates in the Eastern Pacific-Caribbean track that is well documented with respect to marine organisms (Rosen 1976:440). Its distribution undoubtedly depends primarily on marine factors.

5. Arizona-Northern Mexico Track. This generalized track extends from Baja California to the region defined by Bequaert and Miller (1973:

fig. 1) as the Nearctic Southwestern Molluscan Province, with the exception of the Colorado and Mojave deserts. The fauna of the Southwestern Molluscan Province is itself composite and involves Cordilleran (and ultimately Holarctic), Neotropical, and Californian generalized tracks. The tracks to the California Borderland all involve disjunctions across the Colorado and/or Mojave deserts.

The track of *Gastrocopta (Immersidens) allyni* leads to sister taxa *G. (I.) ashmuni* (Sterki, 1898) and *G. (I.) cochisensis* (Pilsbry and Ferriss, 1910) of Arizona and New Mexico, across a trans-Sonoran disjunction. The sister taxon of *Gastrocopta (Immersidens) rixfordi* is probably *G. (I.) dalliana* (Sterki, 1898) of Arizona, Sonora, and northwestern Chihuahua (Bequaert and Miller 1973). The track of *Vertigo ovata* leads to the Nearctic Southwestern Molluscan Province and thence to a very large portion of the Nearctic realm (summarized by Bequaert and Miller 1973: 92–93).

The track record of the Bulimulidae is complex. According to Christensen (1978), *Berendtia*, *Spartocentrum*, and the *Rabdotus* of Baja California form a monophyletic group. (Breure [1979] suggested that further work might show *Berendtia* and *Spartocentrum* to be synonymous; author Christensen thinks this is highly unlikely.) Hoffman's (1988) assignment to *Naesiotus* of many Baja Californian species formerly referred to *Rabdotus* implies the presence of at least two ancestral bulimulid stocks in Baja California, both of which have undergone significant local radiation. In both cases, the extralimital sister groups appear to be taxa of the Nearctic Southwestern Molluscan Province: in *Rabdotus*, *Rabdotus baileyi* (Dall, 1893) and related species from Sonora; in *Naesiotus*, the group including *Naesiotus nigromontanus* (Dall, 1897), *N. christensenii* Miller and Reeder, 1984, and *N. milleri* Hoffman, 1987, from Sonora and southern Arizona. The Nearctic Southwestern group of *Naesiotus* is disjunct from other species of the genus, which are South American and Galapagan (Hoffman 1988, fig. 3).

Thysanophora hornii occurs in the Nearctic Southwestern Molluscan Province and also in Sinaloa, Jalisco, Nuevo León, Tamaulipas, and San Luis Potosí (Bequaert and Miller 1973). Additional species of *Thysanophora* occur in Central America, the West Indies, and northern South America. Its track therefore connects southern

Baja California with both the Nearctic Southwestern Molluscan Province and the Neotropical region.

The track of *Radiocentrum* extends through northern Chihuahua to southern Arizona and New Mexico (Hochberg et al. 1987), with Quaternary fossils in Texas and northern Coahuila. Late Cretaceous and early Tertiary fossils extend the track northward to Alberta. A trans-Sonoran disjunction exists with respect to *Radiocentrum avalonense* (Hemphill in Pilsbry, 1905) on Santa Catalina Island, California. The phylogenetic relationship between *Greggelix* and other genera of Helminthoglyptidae is not known (Miller 1972); an Eocene fossil questionably referred to *Greggelix* occurs in Chihuahua, Mexico (Roth and Megaw 1989).

The various land molluscan regions of Baja California participate unequally in these generalized tracks. From Table 3 it is evident that the predominant relations of the Californian region are northward along the Peninsular Ranges-California Borderland track and secondarily (based strongly on the contribution of the Northern Montane zone) to the Cordilleran track. A minor element is Neotropical. The relations of the Sonoran region are about evenly divided between, on the one hand, the Peninsular Ranges-California Borderland track and, on the other, the Neotropical and Arizona-Northern Mexico tracks. At the level of zone, the fauna of the Vizcaino Desert zone participates most strongly in the Peninsular Ranges-California Borderland track, while that of the Gulf Coastal zone participates most strongly in the Neotropical and Arizona-Northern Mexico tracks. The Magdalenan zone fauna is more evenly balanced, reflecting the transition between northern and southern faunas pointed out by Christensen (1983). The sparse fauna of the Colorado Desert zone participates in the Colorado/Mojave Desert and Arizona-Northern Mexico tracks. The relations of the Cape region are primarily along the Arizona-Northern Mexico track and secondarily along the Neotropical track, with minor Cordilleran and Peninsular Ranges-California Borderland elements.

A striking aspect of the track record is the near-absence of species shared by the Californian region and the Nearctic Southwestern Molluscan Province (the latter being taxa with an Arizona-Northern Mexico track). *Vertigo berryi* occurs in

California and also marginally in the Southwestern Province; Pleistocene fossil remains show that it was formerly more widely distributed in the latter. The only other shared species is the "weedy" *Paralaoma caputspinulae*. Other tracks connecting the California Borderland with the Southwestern Province involve dramatic disjunctions between related species, as in *Radio-centrum*, or the still more remote relationships between genera of the Helminthoglyptidae as suggested by Bequaert and Miller (1973). Cladistic relations among helminthoglyptid genera still have not been worked out, and their phylogenetic history is probably complex. Ultimately, the phylogeny of the Helminthoglyptidae will provide valuable new information on the biogeography of Baja Californian land mollusks.

RESUMEN

La fauna indígena de moluscos terrestres de Baja California consiste en 117 especies y subespecies, de 36 géneros y de 18 familias. Todos ellos son Pulmonata, excepto el prosobranquio anfibio *Truncatella*. Además hay tres especies introducidas por las actividades de hombres. Se describen dos nuevas especies, *Rabdodus (Plicolumna) perhirsutus* (Bulimulidae) y *Greggelix (Martirelix) huertai* (Helminthoglyptidae). Se presentan listas de localidades, notas sinonímicas, y mapas de distribución. Se definen tres regiones malacofaunísticas: "Californian," "Sonoran," y "Cape." Además, las regiones "Californian" y "Sonoran" están divididas en zonas. Estas divisiones zoogeográficas corresponden por la mayor parte a otras divisiones botánicas y zoológicas propuestas para Baja California.

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